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ABSTRACT

Designed for those who are concerned with gathering job performance information, this manual presents methodology and techniques used to analyze jobs and to record the analysis. Chapter 1, an introduction, discusses briefly the uses of job analyses in trade and technical course construction and instructional materials development, in career counseling and placement, as well as in competency and performance evaluation. Job analysis principles are presented in chapter 2: Complete and accurate identification of the job, complete and accurate description of the tasks of the job, and indication of the requirements the job makes upon the worker for successful performance. The other four chapters contain explanation and instructions for developing the various sections of a job analysis schedule. Chapter 3 deals with the first four items on a schedule (Job Title, Data and Number of Sheets, Alternate Titles, and Dictionary Title and Code). Chapter 4 deals with the "Work Performed" item of a schedule, which should present a statement regarding the tasks performed by a worker in accomplishing the purpose of his/her job. The guidelines for writing this section include focus on introductory sentences, task arrangement, treatment of unusual equipment and terms, and citation of degree of skill and percent of time. Chapter 5 covers the items on a schedule dealing with performance requirements: Responsibility, Job Knowledge, Mental Application, and Dexterity and Accuracy. Chapter 6 deals with the comments section of a schedule: Equipment, Materials and Supplies, Definitions of Terms, and General Comments. Three model job analysis schedules are appended: Part Programer (Numerical Control), Lubrication Man (Vehicle), and Check-Out Clerk (Grocery Store). (JT)

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JOB PERFORMANCE ANALYSIS FOR EDUCATORS AND TRAINERS

by

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Delaware Occupational Teacher Education Consortium
Newark, Delaware 1976

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PREFACE

Job Performance Analysis is a mechanism that links the process of learning with requirements of the world of work. This book is designed for those who are concerned with gathering job performance information. Fundamental uses of such information include trade and technical course construction and instructional materials development, career counseling and placement, as well as competency and performance evaluation.

In preparing this work the author drew heavily on the Training and Reference Manual for Job Analysis, U.S. Department of Labor; Washington, D.C., 1965. Changes have been made, but basically the techniques and procedures presented are the same as those developed by the Branch of Occupational Analysis and Employer Services, U.S. Training and Employment Service.

It is the aim of this book to provide an authoritative source on a methodology and techniques used to analyze jobs and to record the analysis.

Prepared by:

Clifton P. Campbell

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CHAPTER I

INTRODUCTION

The craftsman or technician who is employed to teach a trade or technology is often selected because of recognized excellence in the work customarily performed on the job. He or she has mastered the required skills, developed a practical understanding of the theoretical requirements of the job, and through hard work and determination achieved pre-imminence among others working at the same job. Such credentials are excellent, and fundamental among requisite qualifications for new trade and/or technical instructors. However, credentials provide little assurance by themselves that a competent worker will be able to teach others the skills and knowledge required for successful job performance.

Teaching is a different occupation from the practice of a trade or technology. It requires of the individual a mastery of new techniques and methods of job performance. From the moment the change is made, from worker to teacher, the expert craftsman or technician becomes a neophyte instructor and remains such until training and experience bring about the desired transition.

To make the change from one occupation to another is as difficult or as easy in proportion to the similarity or lack of similarity between the two. In this case, the expert craftsman or technician benefits through the retention of skills and understandings

in the work performed on the job. However, it is foolhardy to assume that he or she will initially be as successful teaching others the rudiments of the job as in performing them. In teaching others successfully, it is necessary to comprehend the psychological and social changes involved in the learning process as well as what to teach, how to teach, the order of teaching, and numerous other important concerns. The expert craftsman who has had recent involvement with apprenticeship, on-the-job or other training programs will be more familiar with the concerns of teaching and learning than a counterpart who is engaged in the full-time practice of that trade or technology.

For the inexperienced trade and/or technical instructor, the "what to teach" can present serious difficulties. This is not because of incompetence but rather because he or she excels in the practice of the trade or technology. To the new instructor, the job is structured as a whole, yet it will have to be presented and learned in parts. To accomplish this requires a systematic analysis followed by a thorough synthesis. Each task which comprises the job must be identified and described to determine the essential skills, knowledge, abilities, and responsibilities required of a successful worker. This information is then restructured into a comprehensible whole that is significant to the learner. For an experienced craftsman or technician, who has reduced a cognizance of the skills and job knowledge to a series of habits, this can be a difficult endeavor.

A considerable amount of the work performed by a skilled

craftsman or technician becomes habitual due to repetition. Naturally, after years of experience little thought is given to much of what is done or how it is done. Many of the skills and understandings that were difficult to acquire seem so simple and obvious that a new instructor may even assume they are common knowledge. Very likely he or she will fail to realize the extent of the vast array of skills and understandings mastered. Because of total personal competency, what he or she teaches could very well be beyond the power of the learner to assimilate. To prevent such an unfortunate occurrence for both students and teacher, expanded efforts in organization are necessary.

Organization must be learned and developed. Just as the craftsman or technician systematized procedures for job performance during the course of his or her work experience, the need for organizing a course of instruction exists. As a result of study and experience, he or she is familiar with and knowledgeable about the factors involved in the trade and/or technology to be taught. If there is a weakness, it is in organizing these factors in a logical sequence to promote and facilitate the learning process. Occupational experience is of limited help in this determination because of its production orientation, with little consideration provided to ease the complexities of the learning situation. In any event, once an individual becomes skilled in the tasks or duties of the job, recollection of what was learned and how it was learned becomes somewhat vague.

Experienced as well as inexperienced instructors have difficulty

in determining the proper relationship of skill to fact or fact to attitude within the learning situation. The problem presents itself the moment they attempt to develop the teaching sequence of skills and facts to be presented. A skill or fact, to be learned, should be based upon previous learning. Where a new skill has little or no relationship to previously learned skills, it would be reasonable to assume that a skill or fact that would provide the necessary connection is missing.

To develop the proper linkage between the job and the processes of counseling, training, and placement it is necessary to have all the job information. The requisite information must be complete and accurate. Consequently, the compiler of these facts must turn to the original and primary source, the job itself. This is accomplished through a complete and accurate job performance analysis.

CHAPTER II

JOB ANALYSIS PRINCIPLES

Job analysis can be defined as the process of determining by observation, interview, and study, and of reporting the significant worker activities and requirements and the technical and environmental factors of a specific job. It is the identification of the tasks which comprise the job and of the skills, knowledge, abilities, and responsibilities required of a successful worker.[1]

Basically, there are three parts to the analysis of any job: (1) the job must be identified completely and accurately; (2) the tasks of the job must be described completely and accurately; (3) the requirements the job makes upon the worker for successful performance must be indicated. The second of these three parts is particularly important. That is, the complete and accurate describing of the job tasks. Without this the rest of the analysis lacks meaning.

The categories of information that must be determined and reported in order to meet the requirements for complete analysis of a job are four in number and have been formalized into a measurement system that is designated as the "Job Analysis Formula". These four

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[1] Training and Reference Manual for Job Analysis. U.S. Department of Labor. (Washington: Government Printing Office, 1965), page 3.

categories are: (1) What the worker does, (2) How it is done, (3) Why it is done, and (4) the Skill Involved in doing it.

Before a job analysis is of value for any use, it must indicate the exact nature and scope of the tasks involved in a job and define the level of difficulty of those tasks. The first three parts of the Job Analysis Formula, the What, How and Why, bring out the nature and scope of the tasks. The last part of the formula, the Skill Involved, measures the degree of difficulty of the tasks and exactly defines the nature of the required skills in order to indicate their difficulty. The Job Analysis Formula will be discussed in greater detail in Chapter IV.

The term "job" is used in many different ways and has various meanings to the individuals using the term. Because terms such as "job," "task," and "element" are often used differently and/or misunderstood, it is necessary to establish somewhat arbitrary meanings for purposes of clarity. The following explanations of each term are provided for the purpose of understanding basic job structure and job analysis methodology.

1. ELEMENT - the smallest unit into which it is practicable to subdivide any work activity without analyzing separate motions, movements, and mental processes involved. It is a work unit that describes in detail the methods, procedures, and techniques involved in a portion of a job.

2. TASK - made up of one or more elements, is one of the distinct major activities that constitute logical and necessary action

by a worker for a specific purpose. It is the work unit that deals with the methods, procedures, and techniques (the "What," "How," and "Why") by which parts of a job are carried out. The effort may involve physical or manipulative activities or mental processes such as analyzing and planning. Such effort may be exerted to change a material or merely to maintain its integrity. The material may be tangible, as metal and paper, or intangible, as numbers and words. Each task has certain distinguishing characteristics.

A. It is recognized, usually, as being one of the worker's principal responsibilities.

B. It occupies a significant portion of the worker's time.

C. It involves work operations which utilize closely related skills, knowledges, and abilities.

D. It is performed for some purpose, by some method, according to some standard with respect to speed, accuracy, quality, or quantity. This proficiency standard may be developed by the worker through trial and error or learned through experience; it may be provided to the worker by a supervisor in the form of oral, written, or graphic instruction; or it may exist as a directive, published operating procedure or some similar form.

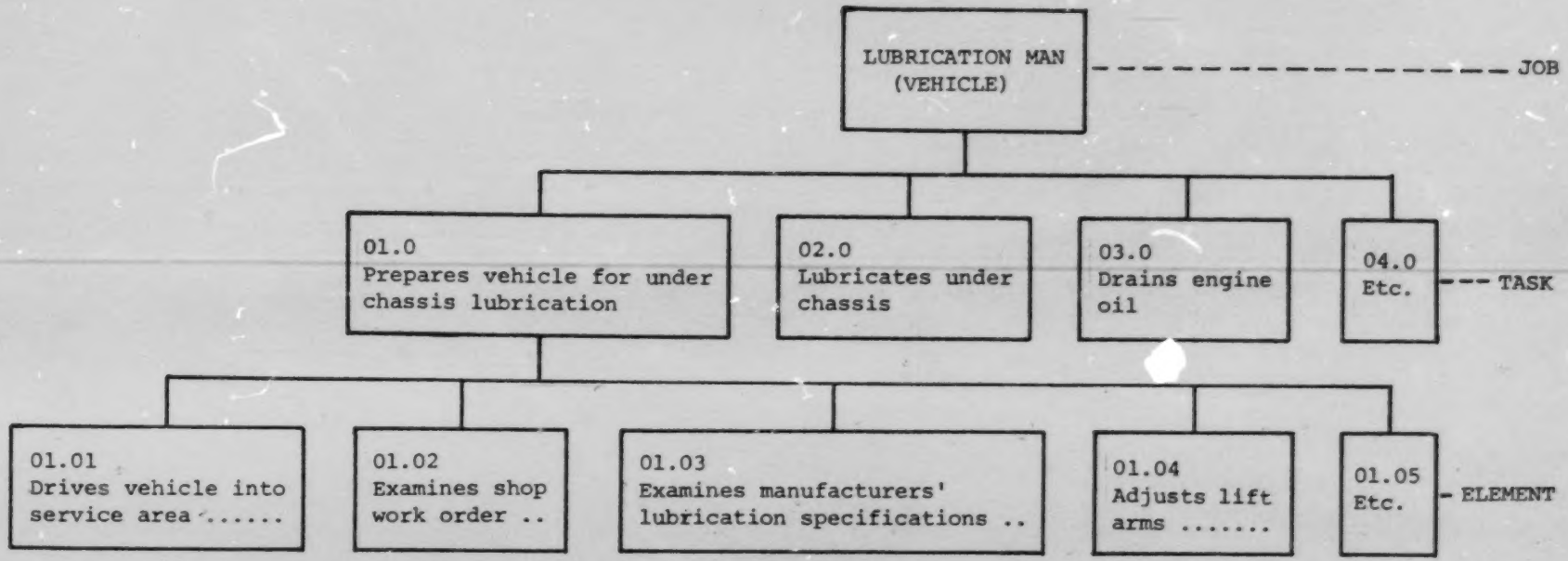
Tasks may be considered major or minor, depending on the extent to which they establish demands for skills, knowledges, aptitudes, physical capacities, and personal traits and upon the percentage of total work time involved in their performance.

3. JOB - a grouping of related responsibilities for human performance called tasks. A person employed to lubricate vehicles performs various lubrication and associated tasks. Such a person is identified as a LUBRICATION MAN (VEHICLE). The titles Numerical Control Part Programmer and Grocery Store Check-Out Clerk also identify jobs. Some jobs, such as Machinist are highly involved with equipment. The tasks which make up such jobs are generally based on the equipment and its operation. Figure 1 illustrates the Hierarchy of a Job by depicting the relationship of elements, tasks, and the job.

The first step in the analysis of a job is an exact determination of what the job is and its precise limits; that is, where the job begins and where it ends. The analyst therefore must be able to discover the exact nature of a job.

Each job analysis schedule must faithfully report the job exactly as it exists in an establishment at the time of the analysis, not as it should exist, not as it has existed in the past, and not as it exists in similar plants. While jobs are, to a certain extent, constantly changing and evolving, the analyst should not speculate on future plans given by employers or on how the analyst believes the job might change in the future.

HIERARCHY OF A JOB



NOTE: To illustrate the relationship of elements to tasks each has been classified by a numerical symbol. Tasks, the major units, are numbered (01.0, 02.0, etc.). The elements which make up each task are related to that task by the first two digits of the numbering system. The last digits show the number of each element (01.01, 01.02, etc.). For example, element 01.02 is the second element of the first task.

Figure 1

CHAPTER III

THE JOB ANALYSIS SCHEDULE

Items 1 through 4 of the job analysis schedule identify a job accurately within the organization in which it occurs. Spaces are provided for entering the (1) Job title, (2) Date and Number of sheets, (3) Alternate titles as well as (4) Dictionary title and code. This identification permits a rapid reference and cross reference to schedules which contain desired information. The job analysis schedule in Appendix A illustrates items 1 through 4 completed in an appropriate fashion.

Item 1, Job Title

Enter the name by which the job is commonly called in the establishment where it is being analyzed. This title should be the one that the employer would use in advertising a job vacancy, or one which the workers use among themselves in referring to the job. The job title should be singular and entered using all capital letters.

If the title appears to be inappropriate or is not descriptive of the job, the analyst should qualify it with a word or phrase in parentheses after the title to make it as precise as possible, i.e., LUBRICATION MAN (VEHICLE). No portion of the job title as designated by the establishment should appear inside the parentheses. Under no circumstances should the analyst devise and insert a title

of his/her own.

The analyst is concerned primarily with reporting facts about jobs in the establishment in which the analysis is being made. However, if he/she knows that there is something unusual concerning the use of a particular title, or if it is so general as to be meaningless, the title should be entered and fully explained in the "General Comments" section, Item 12, of the schedule and, where necessary, appropriate titles should be suggested.

Item 2, Date and Number of Sheets

The date on which the analysis was made and the total number of sheets in the schedule should be noted here. The number of each page should also be placed in the top right portion of the sheet together with the total number of pages. For example, Page 1 of 16. This practice should be continued throughout the job analysis schedule just as has been done in the example which appears in Appendix A.

Item 3, Alternate Titles

Enter here in capital letters any titles, other than the one entered in Item 1, by which the job may be known. These titles should be terms which are widely used and recognized in the plant or at the work site. The inclusion of alternate titles in this space is taken to mean that the titles are synonymous with the main title and that the entire analysis as written applies to all the titles listed. For example, LUBRICATION TECHNICIAN, LUBRICATOR, and INSIDE QUICK SERVICE SPECIALIST were found to be alternate titles for LUBRICATION MAN. On

the other hand, Cash Register Operator and Scale Operator are not alternates for Grocery Store Check-Out Clerk because they refer to only a portion of the work done by the incumbent worker.

Item 4, Dictionary Title and Code

If the job being analyzed can be identified in volume I of the Dictionary of Occupational Titles, the Dictionary title and code should be entered here. It must be remembered, however, that a complete entry can be made here only when the job under analysis is identical in all significant respects to a job defined in the Dictionary.

CHAPTER IV

WORK PERFORMED

This section of the job analysis schedule is intended to present a clear, complete, concise, and factually accurate statement regarding the tasks performed by a worker in accomplishing the purpose of his/her job.

The extent of a job is determined by the total of all the tasks which must be performed on the job and by their specific nature. In the job analysis schedule, the extent of a job is established by the Work Performed and by associated descriptions of Equipment, Materials, and Supplies noted in the Work Performed. To define clearly the scope of the job, the Work Performed must describe what the worker does, how it is done, and why it is done. This portion of the schedule satisfies the first three parts of the Job Analysis Formula. The manner in which the information should be presented will be explained and discussed in detail.

Item 5, Work Performed

The Work Performed item must present, in concise form, a thorough and complete description of the tasks of the job. It should give a correct portrayal of the identity, purpose, content, and requirements of the job. However, it is not meant to be a detailed time and motion study. See Figure 2. It should consist of an introductory

WORK PERFORMED

Purpose:

To present, in concise form, a thorough and complete description of the tasks of the job.

Function:

1. It must illustrate correctly the job's
   A. Identity
   B. Purpose
   C. Content
   D. Requirements
2. It is not to be a detailed time and motion study

Figure 2

sentence that gives an overall identification to the job, followed by an orderly series of statements that describe each step of the job.

Introductory sentence. The introductory sentence of the Work Performed item is a composite job statement which orients the reader with respect to the scope of the job. Its function is to give the reader, in as few words as possible, an overall understanding of the purpose, nature, and extent of the tasks performed, and to show how the job differs generally from other jobs. In composing this sentence the selection of words is important. The terms used must be sufficiently precise to highlight the important aspects of the job and to distinguish the job from others. If the analyst cannot avoid the use of general terms, they must be qualified and explained in subsequent material. When writing this introduction, the analyst should ask:

1. What outstanding factor in this job differentiates it from all other jobs?
2. What words can be used in writing this sentence that will convey the most precise meaning to all readers?
3. What details should be added to the sentence that will clarify the total picture?

Figure 3 reviews the purpose and criteria for the introductory sentence. The following are two sample introductory sentences taken from Job Analysis Schedules which appear in Appendix B and C, respectively. The Job Analysis Schedule in Appendix A provides another example of an appropriate introductory sentence.

INTRODUCTORY SENTENCE

Purpose:

A composite job statement which orients the reader with respect to the scope of the job by providing an overall concept of the purpose, nature, and extent of the tasks performed, showing how the job differs generally from other jobs.

Criteria:

1. What outstanding factor in this job differentiates it from other jobs?
2. What words should be used to convey the most precise meaning?
3. What details are needed to clarify the total picture?

Figure 3

LUBRICATION MAN (VEHICLE)

Lubricates bearings, bushings, and gear boxes with a hand operated grease gun, hand operated gear lubricant dispenser, oil can, squirt can, and stick lubricant in accordance with the shop work order and manufacturers' specifications to reduce wear and extend the useful life of a vehicle.

CHECK-OUT CLERK, GROCERY STORE

Itemizes, tabulates, and bags, boxes or wraps customer purchases, operates a cash register to determine the total cost of merchandise purchased, collects payment and makes change.

The remainder of the Work Performed section consists of an organized presentation of the tasks of the job. This presentation expands upon the introductory sentence and explains the important details of the job so logically, concisely, and specifically that an uninformed reader can gain a clear understanding of the work performed.

Task arrangement. The tasks that comprise a job should be arranged in either a (1) chronological or a (2) functional order. Tasks can be arranged chronologically when a job has a specific cycle or sequence of operations. The analyst should describe the tasks the worker is regularly called upon to do in the order in which they are performed. The chronological order should begin with the first task the worker is called upon to do and consider the work steps successively. Figure 4 provides an example. The tasks of a Numerical Control Part Programmer could be arranged in the following

TASK ARRANGEMENT

Chronological:

Used where tasks are performed in a definite cycle or sequence of operations.

Tasks are described in the order the worker performs them.

Example: A typical machine operator

1. Sets up machine
2. Mounts work piece
3. Operates machine
4. Removes work piece
5. Inspects work piece
6. Maintains tools
7. Maintains machine

Figure 4

chronological order.

1. Coordinates preplanning
2. Prepares part drawings
3. Prepares part program manuscripts
4. Occasionally operates Tape Preparation Machine
5. Occasionally operates key punch machine
6. Occasionally operates various numerically controlled machine tools
7. May observe tape verification on N/C machine

See Appendix A for a complete list of tasks. Job tasks can usually be arranged chronologically with factory-production type jobs, jobs that are relatively simple, or jobs for which the skill involved is limited.

A functional arrangement of job tasks should be used by the analyst for jobs having no regular cycle of operations. This type of job is usually more difficult to analyze, since it involves a considerable variety of tasks that generally have no established sequence of operations. The functional arrangement is used frequently for clerical, technical, managerial, and professional jobs.

For example, the tasks of a secretarial job may be arranged as follows:

1. Types narrative and statistical reports
2. Tabulates and posts data in various record books
3. Files correspondence and reports
4. Receives callers, and provides them with information

5. Prepares purchase requisitions, and distributes supplies

Such tasks are described separately and independently of each other in whatever order the judgment of the analyst indicates. See Figure 5.

Normally, each of the items listed chronologically in the previous discussion as typical major steps in Numerical Control Part Programming would constitute one numbered task. All of the details explaining that task would be stated directly under it. The primary consideration is to organize the statement so that the uninformed reader can obtain a clear understanding of the work performed on-the-job.

Especially important in giving a clear understanding of the work performed on a job is the style in which the analyst prepares the presentation. The presentation should be a concise, well worded, easily read and understood, narrative constructed on the outline of the organization decided upon. It must not be the outline itself. In a narrative the analyst constructs the job as analyzed. In an outline the reader is forced to construct the job, a situation that is highly susceptible to error.

The information given must be specific and must contain sufficient detail to satisfy the requirements of the first three parts of the Job Analysis Formula, "What," "How," and "Why." It must not, however, confuse the reader with a mass of relatively unimportant facts. It is necessary and important to observe and evaluate accurately all of the details of the job, and then to segregate and

TASK ARRANGEMENT

Functional:

Used in jobs having no cycle of operations.

Tasks are described separately and independently of each other in whatever order the judgment of the analyst indicates.

Example: A secretarial job

1. Types narrative and statistical reports
2. Tabulates and posts data in various record books
3. Files correspondence and reports
4. Receives callers, and provides them with information
5. Prepares purchase requisitions, and distributes supplies

Figure 5

record only those that are pertinent to the "What," "How," and "Why".

The fourth category of the Job Analysis Formula, the "Skill Involved", must also be carefully considered in presenting each job task. The "Skill Involved" consists of such factors as Responsibility, Dexterity and Accuracy, and Job Knowledge, all of which will be reviewed in the PERFORMANCE REQUIREMENTS section. Whenever possible, the Work Performed must be so worded that the "Skill Involved" in the tasks can be directly related to the PERFORMANCE REQUIREMENTS.

Flag statement. In composing the body of the Work Performed section so as to obtain the clearest presentation, the analyst should divide the job into its major tasks and allocate one numbered statement to each. Each task is presented in flag statement form which shows generally what is being done. The flag statement is abrupt and descriptive of what is included in the paragraphed statement which comes after it. See Figure 6. The following is a task taken from the job analysis schedule for a Numerical Control Part Programmer; the flag statement is "Coordinates preplanning."

1. Coordinates preplanning: Analyzes engineering drawings, sketches and conventional or mathematical-analytical design data to determine advisability and suitability of using Numerically Controlled Machine Tools to manufacture particular parts by determining intent of designer, and visualizing workpiece configuration, noting machining operations to be accomplished and the particular capabilities of N/C machines. Confers with design and drafting

TASK DESCRIPTION

Flag Statement:

A form used to present each task in the narrative report.

An abrupt and descriptive statement of what is included in the narrative which follows.

Examples:

1. Sets up lathe:
2. Examines blue prints:
3. Cuts rafters:
4. Supervises operations:
5. Cuts hair:
6. Sharpens cross-cut saws:
7. Evaluates methods of teaching:

Figure 6

personnel, applying specialized knowledge of machining workshapes by N/C to determine manufacturing feasibility and product machinability and to recommend changes in design and drafting practices to reduce time and cost of part programming and permit utilization of N/C machining process (See comments). (3-10%)

The Work Performed section should include all tasks whether they are performed regularly or infrequently. Tasks such as the occasional operation of a Tape Preparation Machine, occasional repair of a unit, and the like should be described with a notation concerning their frequency of performance. Infrequently performed tasks have a flag statement preceded by the word "Occasionally." Tasks that are not normally included in the job are preceded with the work "May." Figure 7 cites examples of these types of flag statements.

The tasks of the job are presented in consecutively numbered and paragraphed statements. The regularly performed tasks (arranged chronologically or functionally) are listed first, followed by infrequently performed tasks, then tasks that are not normally included in the job. See Appendix A for a comprehensive example of task listing.

Guidelines for Writing

The Work Performed section should be written in a clear and concise manner. Guidelines for clarity include:

1. Choose easily understood words which impart necessary

TASK DESCRIPTION

Types of Flag Statements:

Denotes regularly performed tasks:

1. Slices steaks, roasts, and ribs
2. Sets up gear cutting machine

Denotes infrequently performed tasks:

1. Occasionally cleans office
2. Occasionally replaces sealed beam units

Denotes tasks that, normally, are not included in the job:

1. May check out customers
2. May pump gas

Figure 7

information.

2. Be precise so the statement has the same meaning to all readers.
3. Avoid the use of abbreviations. However, when deemed advisable spell out the term followed by the abbreviation in parentheses the first time it is used, then use the abbreviation as necessary.

Suggested guidelines for conciseness require that all necessary information be provided in well chosen words with specific meanings. Avoid statements which are too broad or general.

1. Begin each sentence with an action verb.
2. Use a terse, direct style of writing.
3. Use the present tense.

These six guidelines govern the style to be followed in preparing the Work Performed section. See Figure 8. The job analysis schedules in Appendix A, B, and C provide examples of writing which adheres to these guidelines.

When the analyst composes a sentence or a phrase describing any portion of the Work Performed, he/she should immediately measure the quality of what has been written by consciously applying the Job Analysis Formula to it. He/she should ask, "Does this statement tell what the worker does?" "Does this statement tell how the worker does it?" "Does this statement tell why the worker does it?" If what the analyst has written answers each of these questions, the quality of information given is assured. If however, any one of these questions

GUIDELINES FOR WRITING

Clarity:

1. Choose easily understood words which impart necessary information.
2. Be precise so the statement has the same meaning to all readers.
3. Avoid the use of abbreviations.

Example:

Correct	Incorrect
Analyzes engineering drawings,	Has responsibility for analyzing eng. dwg's.,

Conciseness:

1. Begin each sentence with an action verb.
2. Use a terse, direct style of writing.
3. Use the present tense.

Example:

Correct	Incorrect
Sketches part to be manufactured,	Does sketches that were necessary prior to the manufacturing of a part.

Figure 8

is left unanswered, the analyst must revise the statement so as to remove the deficiency that the formula has brought to light.

As stated previously, the fourth part of the formula must not be neglected in the analyst's evaluation of what he/she has written. Statements should tell what is involved in the worker's performance of each task so that there will be an adequate tie-in between the Work Performed and PERFORMANCE REQUIREMENTS.

Every precaution should be taken to use words that have only one possible connotation and that specifically describe the manner in which work is accomplished. Expressions such as "transports material" should be avoided. Instead specificity such as, the worker carries the materials in a box, or pushes a loaded dolly, or drives an electric truck, should be provided. To cite another example, it is inadequate to record merely that a worker "feeds the machine." This precipitates questions such as, are the workpieces inserted one at a time, are they inserted manually or automatically, are they held by a jig or fixture?

The analyst should keep in mind the necessity for stating a task completely but should not allow the explanation to develop into a motion study. For example, regarding an inspector of small parts, it may be said, "slides fingertips over machined surfaces to detect ragged edges and burrs". On the other hand, it would be absurd to state, "raises right hand eight inches to bench height, superimposes hand over machined part and, by depressing the first and second fingers to the machined part and moving the arm slowly sidewise to the

right about six inches, feels with fingertips for burrs or sharp edges that are indicative of surface irregularities."

Treatment of Unusual Equipment and Terms

In recording the tasks under Work Performed, the analyst must be careful to mention all equipment which is used by the worker. Any special or unusual equipment, machines, tools, or other such devices should begin with an initial capital letter(s) the first time they appear in the Work Performed section. Those which are defined under Item 10, Equipment, Materials, and Supplies, should be underlined the first time they appear. Similarly, all technical or little-known terms or terms with unusual meanings, which are defined under Item 11, Definitions of Terms, should be underlined the first time they appear in the Work Performed section. This is necessary so that the reader will know immediately that the definitions are in the schedule and that he/she can turn to them for information.

Citation for Degree of Skill and Percent of Time

The tasks of the job are presented as consecutively numbered and paragraphed statements. At the end of each statement is a parenthetical notation giving the approximate degree of skill and percent of time involved in the performance of the task described. Both the degree of skill and percent of time provide valuable clues concerning the emphasis to be placed on the various tasks by the user of the job analysis schedule.

The degree of skill required to perform each task is indicated

with a numerical rating from a scale of 1 to 3. The lowest degree of skill is represented as level "1" and the highest as level "3". When assigning the ratings to tasks in a job, only the job being analyzed is considered. This is important because it is not possible to compare the tasks involved in different jobs. What might be a level "3" skill for a task of one job might only deserve a rating of "1" in another, depending on the complexity or similicity of the jobs. Every job will contain a level "3" task, since every job has its own "most difficult task".

The total percent of time involved in the performance of all the tasks in a job should equal 100 percent. Estimates made by the analyst should be tempered and/or verified by consulting the worker whose job is being observed and the worker's supervisor. Since it is impractical to attempt extremely fine determinations of the percent of time taken up by each separate task, no figure less than 5 percent should be used.

In assigning the degree of skill and the percent of time for a task, the degree of skill should be noted first and the percentage of time second. The two should be separated by a hyphen and enclosed in parentheses. Thus, a skill level of 3 for a task consuming 10 percent of the worker's time would be noted (3-10%).

CHAPTER V

PERFORMANCE REQUIREMENTS

This component of the job analysis schedule presents the requirements the job places on the worker for successful performance. It is a detailed interpretation of the basic minimum skills, abilities, responsibilities and knowledge required of the worker. This information expresses the Skill Involved in doing a job in specific terms. The items in this section include the highly important explanatory information necessary to complete the job analysis formula, the What, How, and Why of which were brought out in item 5, Work Performed.

A description of the work performed by the worker will produce an accurate understanding of the physical and manipulative portions of the tasks. However, it is equally important to know what knowledge, training, and experience are needed to execute those tasks at the right time, in the right order, and in the right manner. Consequently, it is necessary to determine whether the execution of the tasks depends on any skills, knowledges, exercise of judgement, or other intangible factors, and to make specific statements emphasizing those factors. This applies to the job as a whole as well as to each separate task. Figure 9 reviews the intent of the PERFORMANCE REQUIREMENTS section.

It has been established by careful investigation that the factors

PERFORMANCE REQUIREMENTS

Intent:

1. To indicate the level of difficulty of the tasks.
2. To express the "Skill Involved" in specific terms.
3. To determine what characteristics the worker needs to execute the tasks successfully.
   - A. Skills
   - B. Knowledge
   - C. Judgment
   - D. Training
   - E. Experience
   - F. Abilities
   - G. Responsibilities

Figure 9

included in this section are adequate and sufficiently comprehensive to bring out properly the skills, abilities, knowledge, and other characteristics required of a worker by any job, regardless of whether the job is craft, technical, clerical, or professional. It might be considered as a guide list to aid the analyst in obtaining and recording all the information necessary to discriminate between jobs and to establish definitely the level of difficulty of any job.

The analyst can be assured that, if this guide list is properly utilized, all of the essential information necessary to supplement the Work Performed will be included in the job analysis schedule and that the schedule will be adequate to classify the job on the basis of level of skill and to assure discrimination between the job analyzed and other closely related jobs. This information is very important to all concerned with the job analysis because it represents the skill components which must be considered in the preparation of most occupational analysis products.

The PERFORMANCE REQUIREMENTS are covered by four specific factors which intermesh:

1. Responsibility
2. Job Knowledge
3. Mental Application
4. Dexterity and Accuracy

The definitions of these factors are to be found on the following pages under numerical headings corresponding to the numbered items of the job analysis schedule. They should be carefully reviewed in

connection with the following discussion.

It is at this point that the information the analyst has obtained about a job, as reported in the Work Performed section, must be supplemented by a detailed analysis of the report itself. This requires a concentrated analysis in the sense of weighing, considering, and evaluating that which has been learned. In preparing a Work Performed section, the purpose is to present a thorough and complete description of the tasks of a job as they exist. In preparing the PERFORMANCE REQUIREMENTS, the analyst must break down the job into four component factors, measure these factors and, by doing so, explain the fundamental nature of the job in terms of its successful performance.

The PERFORMANCE REQUIREMENTS primarily serve to establish the level of difficulty of the tasks described in the Work Performed, and, in so doing, aid in identifying the job tasks and in clarifying the "What," "How," and "Why" described in the Work Performed. This level of difficulty should not be confused with the "degree of skill," a parenthetical notation used in the Work Performed section.

In attaining this objective, the analyst should review carefully each task of the Work Performed in the light of the PERFORMANCE REQUIREMENTS, noting the presence and degree of each factor that is involved in the task. If this is done properly, the description of factors present in the total job will be complete and will cover the skills, abilities, and knowledge required of the worker. Treatment of this kind will avoid highly involved writing which would be necessary if the attempt were made to state the skills required for each task

within the Work Performed section.

For this reason, the analyst usually will find it desirable to complete this section immediately following the preparation of the Work Performed. Each task then can be reviewed separately and the presence and degree to which each factor is involved in the task can be determined. This information then should be consolidated so that the written statement for each factor covers the degree to which that factor is involved in all the tasks which make up the job.

It must be emphasized that the mere statement that a given factor exists or does not exist is not sufficient. The degree to which it exists should be stated specifically. For example, under the factor "Responsibility," the fact that a worker is responsible for the safety of others means little by itself. The responsibility of the worker for what injuries to which worker(s) and the extent of the resulting injuries must be explained. In this connection, it is important to note also the degree to which the worker is responsible or is not responsible for the initial occurrence of the accident.

While the Work Performed and the PERFORMANCE REQUIREMENTS must be related to and must support each other, these two sections are fundamentally different. The PERFORMANCE REQUIREMENTS may be considered as devices which evaluate the Work Performed, measure its level of difficulty, and determine the exact nature of the tasks.

The PERFORMANCE REQUIREMENTS will contain some information already given in the Work Performed because the two are related closely in terms of the tasks performed. In addition, the PERFORMANCE

REQUIREMENTS constitute a synthesis of all information, either stated or implied, concerning each factor throughout the scope of the job.

In many cases, it will not be possible to differentiate sharply between informational statements which must be given in more than one of the factors which make up the PERFORMANCE REQUIREMENTS. Such information may overlap or contain conditions which form a part of two closely related factors, such as Job Knowledge and Mental Application. However, the analyst should experience little difficulty, provided he/she describes each factor in terms of the definition of that factor. In many cases, the analyst will find that the same information, in different terms, must appear in two or more factors in order to give a clear understanding of what is involved in the job. This is not to be considered as duplication but as different viewpoints of the same circumstance.

All factors which are stated as existing in a job should be reflected in and related to the Work Performed. It should be possible for the schedule reviewer to refer to the Work Performed and find the exact phases of the work which are conditioned by a specific factor. Conversely, the reviewer should find it possible to locate in the PERFORMANCE REQUIREMENTS all the skills, abilities, and knowledge necessary to perform any task which is mentioned in the Work Performed.

Entries under this section will not follow a rigid writing style. Whenever possible the statements should be written in the form of requirements. That is, the subject (the worker) is understood and need not be specified. Therefore, each statement will begin with a

phrase such as: "Solely responsible for," "must be able to," "must be alert to," "must have feel for," or similarly appropriate wording.

When composing the entries, the analyst should avoid the use of generalized words such as "normal," "careful," and the like which mean little except in a relative sense. In most cases, specific examples can be given, comparisons drawn, or limits described which will define accurately the degree to which a factor exists, and by so doing, will eliminate the necessity for overall limiting words. The analyst often will find it desirable to draw on his/her knowledge of jobs other than the one under consideration to provide a means of comparison.

In completing this section, the analyst should bear in mind that, since the PERFORMANCE REQUIREMENTS constitute fundamental information, there should be no omissions. The non-existence of any given factor in a single job, or its existence to a low level, provides pertinent information about that job as does the existence of any other factor, no matter how high the degree. It is, therefore, just as deserving of comment in the schedule as any other factor concerned with the job. In comparing jobs on the basis of job analysis schedules, the non or low level existence of information often provides specific clues to the nature of the jobs involved.

In order to make clear the type of information desired under each factor, each of the factors is discussed separately in items 6 through 9.

Item 6, Responsibility

This factor relates to (1) the nature and extent of supervision

received and/or exercised, (2) the number of checks set up to prevent or catch errors, (3) the limits placed on decisions the worker makes, (4) the degree of loss that would result from error, or the saving that would be effected by foresight, and (5) other limitations placed on the responsibility of the worker.

Considerations affecting this factor include:

1. Does the worker delegate duties to others? To whom? How?
2. Does the worker coordinate the efforts of subordinates? How?
3. Is the worker accountable for progress, quality, the safety of others, and costs of the work?
4. Does the worker train others? Whom?
5. What are the nature and the magnitude of supervisory control?
6. Does the work require contacts with outsiders or others in the organization not in line of authority? Of what nature and with whom?
7. What are the nature and scope of commitments made?
8. To what extent is the work verified by others?

Jobs must be examined for the presence and relative amount of each of these considerations, if a true understanding of the total responsibility involved is to be presented.

The kinds of responsibility that exist in a job are usually relatively easy to determine and to interpret in quantitative terms; that is, in terms of the money value of equipment, materials, or products that the worker could ruin, the relative likelihood of spoilage or damage, the number of subordinates supervised, the

cooperative effort required, or the nature and extent of possible injuries the worker could cause through carelessness.

Sentences in the statement of Responsibility usually begin with a phrase such as; "Is responsible for . . .," "Solely responsible for . . .," etc. The following sample statement of Responsibility is taken from the job analysis schedule for an N/C Part Programmer which is included in Appendix A.

6. Responsibility

> Is responsible, under limited supervision, for a variety of activities such as resolving questions of design intent, determining suitability and availability of standardized tooling and fixturing, analyzing alternative part programming methods and machining sequences, and reviewing computer output during the course of a single assignment. Responsible for making decisions on a judgmental basis using past experience and knowledge to select the best part programming techniques, sequence of machining cycles and incorporating portions of previously prepared part programs without trying out alternative methods, thereby reducing time and cost of preparing manuscripts. Responsible for making decisions on a factual basis, such as when assigning feedrates and speeds previously found to provide optimum balance of such factors as accuracies and surface finishes, machining time, and tool life. Utilizes accepted standards in recording processing statements in specialized part programming formats and languages. Adheres to standardized nomenclature when preparing setup instructions for operators and in complying with established machine feedrates and speed conventions. Responsible for providing close supervision and guidance when training workers in the programming, use, operation, and maintenance of N/C machines and peripheral equipment. Responsible to management for technical assistance in long-range N/C planning including time studies, cost analysis, job evaluations and recommendations for the acquisition of new equipment.

Item 7, Job Knowledge

This factor refers to the practical knowledge of equipment,

materials, working procedures, techniques, and processes required of the worker for the successful handling of a job. The practical knowledge requirements include that which is a prerequisite to appointment as well as that which must be acquired after appointment to perform efficiently.

Job knowledge includes the amount and complexity of knowledge required of the worker by the job. Such knowledge may be gained by actual on-the-job experience, formal courses, training programs prior to entry on the job, or by all such methods. When thinking of this factor, consideration should be given to a variety of specifications, materials, and assignments encountered, and guidelines governing decisions and operations, such as precedent, regulations, standards, and practices.

Consideration should also be given to such requirements of pre-employment or on-the-job knowledge as:

1. Knowledge of machines and equipment used
2. Knowledge of materials used
3. Knowledge of working procedures and techniques
4. Knowledge of product flow or process as related to the job
5. Knowledge of dimensional or formulary calculations

When writing the Job Knowledge requirements, the analyst must review all the tasks which make up the job and determine just what specific knowledges the worker must have for satisfactory performance and the extent of each required knowledge. The extent of knowledge

usually can be brought out only by a very careful choice of words and by specific statements. The statement "Must have a thorough knowledge of heat-treating metals " does not give an exact explanation of the extent of the knowledge required since the statement is too general. However, if it were stated, "Must know the heat-treating temperatures and types of quenches to be used when hardening, annealing, or normalizing steel parts," the specific knowledges required would be brought out and their extent indicated adequately.

The following example statement of Job Knowledge is taken from the job analysis schedule for an N/C Part Programmer which appears in Appendix A.

7. Job Knowledge

> Must have numerical ability at the level of shop arithmetic, geometry, trigonometry, analytic geometry and calculus to comprehend functions of N/C systems and prepare part programs, along with non-decimal arithmetic and Boolean algebra to comprehend functions of N/C system, read and interpret machine control tapes and MCU display lights. Mathematics at the level of vector analysis is required to select from alternate part programming methods, and achieve optimum balance of part programming, computer processing and machining time. Must have spatial ability to visualize raw and finished parts from engineering drawings, sketches and mathematical descriptions, avoid tool collisions, envision detailed sequence of machining cycles that will produce the part most efficiently and produce tool lay-up and setup sketches . . .

Item 8, Mental Application

"Mental Application" refers to the exercise and maintenance of mental processes required to perform properly the duties of a job. It may be stated as the degree and continuity of thought, mental

planning, or mental alertness that must be exercised in performing an operation. It includes mental concentration required because of diversity of work or variety of problems.

Considerations affecting this factor include:

1. INITIATIVE - the need to face and solve new problems. This involves mental resourcefulness, analytical ability, the making of decisions, and the taking of independent action and should be considered according to the probable frequency of occasions on which the job will require it outside the control or routine of supervision.

2. ADAPTABILITY - the versatility required of the worker or the need, or lack of need, for the worker to adequately handle frequent changes in assignment or to carry on several tasks simultaneously.

3. JUDGMENT - the amount of independent decision making that must be exercised by the worker in performance of a job. The importance of results obtained by such independent decision making or the extent of the consequences of poor judgment must be considered.

4. MENTAL ALERTNESS - the attention necessary to tend and feed a machine properly, attention which must be given to orders, and alertness necessary to prevent damage to equipment and materials or injury to personnel.

When describing the degree to which this factor is present in a job, the analyst must consider questions such as: "Is the job repetitive or non-repetitive?" "What degree of supervision does the worker receive?" "What must the worker decide for himself and what are the consequences of poor judgment on his part?" "Must the worker

improvise expedients in the course of his work and why is this necessary?" All of these points and many others are usually indicative of the Mental Application required of a worker by a job.

The analyst must not stop after determining the presence of those points which contribute to the total Mental Application in a job but must clearly indicate the degree to which they occur. If, for example, little initiative is required due to close supervision, an appropriate statement should be made. Or, if a worker must possess considerable adaptability to handle frequent changes in assignment, typical assignments should be mentioned to indicate specifically the degree of adaptability required.

The analyst must follow this procedure carefully in order to build a true understanding of the Mental Application required in any job. The following Mental Application statement is taken from the job analysis schedule for a N/C Part Programmer, which is included in Appendix A. It illustrates the principles outlined.

8. Mental Application

> Must take initiative to confer with design, engineering and operating personnel about difficulties in design interpretation, part programming, machining and maintenance. Must be able to plan and write concise, unambiguous part program commands and operator instructions. Must be mentally alert and able to form clerical perceptions, to visualize pertinent details, distinguish symbols on drawings and sketches, and to identify, record, and verify numbers, letters, words and special symbols that make up the machine commands of the part programming language. Must be able to coordinate planning, and decide method and sequence of operations by which parts are to be manufactured. Must be constantly alert to avoid errors in planning, programming and manufacturing parts by N/C. Must be alert to possible errors in engineering drawings.

Must use professional judgment in preparing part drawings, tooling analysis and part programming manuscripts for product manufacturing.

Item 9, Dexterity and Accuracy

This factor refers to the manipulative ability required in performing given work to a required degree of accuracy or precision and to the complexity or intricacy of manual processes involved. The characteristics to be considered here include (1) dexterity, (2) accuracy, (3) coordination, (4) expertness, (5) care, and (6) deftness required in manipulating, operating, or processing the materials, tools, instruments, machines, or gauges used. The number of units of work normally produced in a given period of time is also a measure of dexterity.

The major considerations affecting this factor are:

1. DEXTERITY - the quickness or deftness required, or the coordination of sight or other senses with the muscles.

2. ACCURACY - the degree of precision required in the handling of product or materials and for the adjustment and manipulation of equipment and tools to the required degree of precision.

The analyst must be careful to use only specific terms which will express the degree of the dexterity and accuracy required by the job. Statements such as "Dexterity is normal" or "Accuracy is close" should not be used because "normal," "close," and other general terms convey very little meaning or diverse meanings to the reader. Rather, this requirement should be written in terms

of specific tasks in order to bring out more adequately the required degree.

Although dexterity, as such, cannot be expressed specifically in terms of the amount or degree required, it is closely related to accuracy which in many cases has specific measures. Often, the precision of work can be stated in terms of allowed tolerances, that is, plus or minus so much from an absolute standard. This range indicates how much work can depart from the ideal without impairment of job performance.

However, the relative ease or difficulty of maintaining a required standard of accuracy must be taken into consideration because a statement of allowed tolerance or required accuracy in itself will not give a true measure. To illustrate this, consider that one-hundredth-of-an-inch tolerance on an engine lathe is easier to achieve than one thirty-second of an inch in the use of carpenter's handsaw because of the nature of the equipment and material used. On the other hand, one-thousandth of an inch is 10 times as fine as one-hundredth, while one sixty-fourth of an inch is only twice as fine as one thirty-second. Yet the care and deftness required to increase the precision in the latter case may be just as difficult as that in the former. Therefore, the analyst should be sure that any requirement of accuracy relates to work performed and to the tools and equipment by which the accuracy is achieved.

The following Dexterity and Accuracy statement is taken from the job analysis schedule for a N/C Part Programmer. It illustrates the principles discussed.

9. Dexterity and Accuracy

> Must have good visual acuity and coordination of sight to analyze engineering drawings. Must be able to discriminate accurately between alphabetical, numerical, and special symbols in order to record them correctly and in sequence on work sheets and manuscripts. Must be able to read technical sketches, conventional and mathematical-analytical design data with absolute accuracy to determine steps and method of manufacture by N/C. Must use extreme care and a high order of manipulative dexterity in preparing part drawings and part program manuscripts. Must be able to set up and utilize various N/C machines and peripheral equipment with considerable care and dexterity to obtain accurate results.

The analyst must remember that this section refers only to manipulative ability and to required physical accuracy or precision. Mental considerations involving accuracy are not included here. A common mistake is to include considerations affecting what may be called "mental accuracy" such as maintenance of accurate records or the accurate planning of a sequence of a task. Considerations such as those belong under the factor Mental Application.

CHAPTER VI

COMMENTS

The COMMENTS section provides the analyst with an opportunity to present the user of the schedule with all the background information of a job which the user may not be able to obtain firsthand. Only too often an analyst has brought much confusion and doubt to schedule users by neglecting to enter the type of information which puts the job into its true perspective. Here the analyst can enter information which cannot readily be entered in other parts of the job analysis schedule. In addition, the analyst is urged to include collateral or supplementary information needed to give schedule users the best understanding of the job and its relation to the process or service in which it was observed.

Item 10, Equipment, Materials, and Supplies

All equipment, materials, and supplies used by the worker should be considered for inclusion in this item. Equipment is presented first, followed by materials and finally supplies. The COMMENTS section of Appendix A shows the recommended format for Item 10 entries.

Equipment. A definition and/or description is provided for all special and unusual equipment. By "equipment" is meant the machines, tools, and other devices which enable the worker to perform the job. Such units should be distinguished by capitalizing the initial

letter(s) the first time they appear in Item 5. Uncommon or unique units should also be underlined the first time they appear and should be listed and defined or described under the Equipment subdivision of Item 10. All other units should be listed, together with the name of manufacturer, model, and size, but need not be defined. All equipment and tools which are commonly known to the layman, such as saws, hammers, adding machines, etc. need not even be listed, since there will be no need for further clarification.

Considerable latitude is allowed in preparing descriptions of equipment, but ordinarily the descriptions must include the following information:

1. Statement of the function of the device
2. Description of the physical appearance of the device and its essential parts
3. If a machine, a description of its operation as it relates to the worker

Only essential features of mechanical equipment should be included in these descriptions. Structural details, such as gear ratio, types of power drive, and similar technical features, need not be included unless the worker has some specific task to perform in relation to them. It usually follows that the description of a completely automatic machine is considerably simpler than the description of one that requires much attention by the worker.

Frequently, for purposes of clarity, it is desirable to follow a typical piece of work through the machine, taking up those operations

that have been mentioned in the elements of the Work Performed. The description should be written so as to aid in presenting an understanding of the worker in the performance of his/her tasks. Any special features of, or attachments to, the machine should be mentioned if they have any definite relationship to the worker.

For simpler devices, particularly for handtools, it may only be necessary to include a definition of the device rather than a complete description. However, in every case the purpose for which the device or machine described is used should be explained in the definition.

In the description of the job, it is better to use the generic names of machines and other devices than to use their trade names, unless there is no appropriate, commonly understood generic name. For example, "Automatic Screw Machine" should be used in preference to "Acme Machine." When describing the machines in this section, the generic name should be followed by a parenthetical explanation, giving the trade name of the machine, the name and address of the manufacturer, and any other identifying information that can be obtained, such as model number or size. This enables persons who may later write from the data contained in the schedules to request catalogs and photographs from the manufacturers. Where a drawing has been included in the job analysis schedule, and where it is practical and desirable, an equipment description may be tied in with the drawing by placing letters appearing on the drawing in parentheses after the parts of the device mentioned in the description.

A convenient technique for composing the best type of description

or definition of an item is for the analyst to be guided by the following general outline:

1. First state the name of the item.
2. Place the item in its general category.
3. State the function of the item.
4. Describe its physical appearance, its makeup, and its essential parts.

The following are typical examples of the manner in which Equipment is thus described:

> Tape Preparation Machine: Teletype Model 33TZ ASR; Strippit Tapetyper Number 80151-000; Dura Mach 10B, 15" Model; and Friden Flexowriter Model 2301. These tape preparation machines have typewriter keyboards, an integral tape punch and reader (code sensing device). They are operated manually through the keyboard in the same manner as any standard electric typewriter. In N/C applications, the operator reproduces the information from the handwritten part program manuscript; this operation simultaneously causes a punched tape and hard copy to be prepared.

> Key Punch: IBM Key Punch. The most common means of recording information into punched cards. The operator transfers data into cards by an operation very similar to typewriting, frequently called "keypunching". Data being punched may also be printed at the top of the card. Basically, there are three types of card punches available: the 24, 26, and 29 card punches.

Care should be taken to see that the use of all equipment noted in this item is clearly indicated in the Work Performed. For example, if a Tape Preparation Machine is defined in this section, and if it does not appear in Item 5 that the worker prepares perforated machine control tapes, the presumption is that the task of operating this unit has been omitted from the Work Performed.

Materials. Under the heading "Materials" should be listed and

described the raw stock that is used up or processed by the worker during the course of his/her tasks. State what the material is, what purpose it serves, and identify it in relation to the worker. A listing (alphabetically arranged) will be made here only where some physical change in the material involved takes place. For example, a BAKER makes bread from flour but in the job of GROCERY STORE CHECK-OUT CLERK there are no materials involved. When no materials are involved, the work "None" appears after the subdivision Materials. See Appendix A for an example. If any items of material need defining because of their unusual or not commonly understood nature, they should be underlined the first time they appear in the schedule and should be defined in the listing.

A typical statement under this heading might be the Materials used by an ENGINE LATHE OPERATOR, FIRST CLASS:

Unfinished aluminum and magnesium alloy castings.

Steel and brass bar-stock.

Here also should be included as Material those items which, while not being markedly changed by the worker, are processed by him. For example, a steel beam in which the worker punches bolt holes or a rough casting which is polished would be considered as material.

Supplies. The analyst often encounters substances which cannot, strictly speaking, be considered either Equipment or Materials. Thus, neither the naphtha used by a PROPELLER MECHANIC for cleaning propeller parts nor the sandpaper used to smooth wood by a PATTERN-MAKER, WOOD falls under either the category of "Equipment" or of "Materials,"

although sandpaper does change the shape of the wood somewhat. Substances of this nature should be described here as "Supplies."

Other examples of what might comprise Supplies are the various items of stock handled by a STOCKROOM CLERK. These items are considered to be Supplies, since the worker does not use them to aid in performing tasks and does not work on them to change their shape or form. He/she merely handles them in the routine of this work.

Ordinarily, Supplies do not have to be defined, and only representative items need be listed. However, if there is some special knowledge required of the worker to process or handle supplies properly, they should be defined in order to bring out better that special knowledge. Similarly, if the nature of the supplies handled affects the job in any way, it should be briefly described. If such items are defined, they should be underlined the first time they appear in the schedule. See Appendix A for a sample listing of Supplies.

Item 11, Definitions of Terms

All unusual or technical terms used throughout the analysis should be underlined the first time they are used in the schedule. The terms thus underlined are to be listed in alphabetical order and defined under this item.

The definitions will vary with the term to be explained, but the definition should explain what the term is, how it is used, and (if an object) what it is used for. The outline of procedure for preparing

definitions, as presented in the discussions on "Equipment, Materials, and Supplies," is wholly applicable to definitions which are to be included here and should be followed for the greatest clarity of presentation.

The analyst must remember that machines, parts of machines, equipment, and tools used by the worker should be described under "Equipment, Materials and Supplies," not under this section.

Appendix A provides examples of the type of entries to be made here.

Item 12, General Comments

The "General Comments" section should be used to footnote all other parts of the job analysis schedule.

It must be remembered that the essential analysis of the job should appear elsewhere in the schedule and that the "General Comments," while important, should distinctly be of an "aside remark" nature.

The analyst must always refer statements made in "General Comments" to the appropriate section of the job analysis schedule. Comments which do not relate to specific sections should be headed "General." Appropriate cross-references also must be made in the sections commented upon.

If, for example, the analyst desired to comment on the title of a job, the schedule entry would appear thus on the face sheet:

1. Job title MECHANIC (See comments).

In "General Comments," the following would appear:

Item 1: This is a payroll title. The analyst suggests the title of TURRET ASSEMBLER because of the nature of the work performed.

The analyst should remember that this is the footnote item of the schedule and that selected research writing rules apply here. These rules can be stated as:

1. All comments should bear a proper cross-reference.
2. Statements of opinion as opposed to statements of fact should be stated as such and, where possible, the reasoning on which such opinion is formulated should be explained.
3. Information which can appear in other sections should appear there and the "Comments" section should be reserved for "aside remarks."

The following are a few examples of the many types of information which can be profitably entered in this section. All the examples are not applicable to the same specific job but are excerpts from several job analysis schedules. See Appendix A for additional examples and Figure 10 for a review of pertinent information.

General: The job of ENGINE LATHE OPERATOR is divided on the basis of skill into three classes, designated FIRST CLASS, SECOND CLASS, and THIRD CLASS.

The ENGINE LATHE OPERATOR, THIRD CLASS, is a learner who is promoted automatically to ENGINE LATHE OPERATOR, SECOND CLASS, at the expiration of 6 months' training time.

The ENGINE LATHE OPERATOR, SECOND CLASS, works on parts involving

GENERAL COMMENTS

Purpose:

1. To provide background information for the job.
2. To footnote points of interest.

Procedure:

1. All information with a point of origin should be noted.
   A. Item 1: This is a ....
   B. Task 1: The store manager ....
   C. Work Performed: The ....
2. All information without a point of origin should be headed:
   A. General: Only recently ....

Figure 10

simple machine setup of a low enough range to be repetitive; maintains ordinary cutting tools, such as cutoff or facing tools; works to liberal tolerances (0.005") and on materials of low cost, such as castings on which no previous expensive machining has been done. He uses the same precision measuring instruments as the ENGINE LATHE OPERATOR, FIRST CLASS. He is not promoted automatically to ENGINE LATHE OPERATOR, FIRST CLASS, but will be considered for such a promotion after 12 months' experience.

Task 2: The number of machines set up and adjusted by the worker varies with the production schedules and the number of employees available to tend the machines.

General: The job's most outstanding characteristic is its repetitive functions. A test to determine applicants' adaptabilities to simple repetitive work might be developed to good advantage for the selection of applicants for this job.

Work Performed: Axminster weaving differs from other carpet weaving in that the wool for the pile tufts is drawn from several hundred long spools rather than from frames or beams. These spools are carefully wound according to a specified pattern by WINDERS so that there will be one length of yarn for each pile tuft in a repeat pattern. The spools are fitted into the loom in their proper order on a continuous sprocket chain mechanism. In the weaving process, this sprocket chain delivers to the clutch arms of the loom a different spool for each weft row.

APPENDIX A

JOB ANALYSIS SCHEDULE
PART PROGRAMMER, NUMERICAL CONTROL

JOB ANALYSIS SCHEDULE

1. Job title PART PROGRAMMER, NUMERICAL CONTROL

2. Date 1 January 1976

Number of sheets 16

3. Alternate titles NUMERICAL CONTROL PARTS PROGRAMMER; PROGRAMMER, NUMERICAL CONTROL

4. Dictionary title and code TOOL PROGRAMMER, NUMERICAL CONTROL 007.187

5. Work Performed

Determines detailed manufacturing steps and instructions, also prepares part program manuscripts and machine control tapes which command machines to perform automatically and in sequence operations necessary to manufacture parts as specified on engineering drawings, sketches and mathematical descriptions, by applying ability to interpret design and engineering data, knowledge of mathematics, properties of metals, and general shop and machining practices, in addition to a thorough knowledge of the capabilities of numerical control (N/C) systems, and methods of programming (See comments).

1. Coordinates preplanning: Analyzes engineering drawings, sketches and conventional or mathematical-analytical design data to determine advisability and suitability of using Numerically Controlled Machine Tools to manufacture particular parts by determining intent of designer, and visualizing workpiece configuration, noting machining operations to be accomplished and the particular capabilities of N/C machines. Confers with design and drafting personnel, applying specialized knowledge of machining workshapes by N/C to determine manufacturing feasibility and product machinability and to recommend changes in design and drafting practices to reduce time and cost of part programming and permit utilization of N/C machining process (See comments). (3-10%)

2. Prepares part drawings: Sketches part to be manufactured, to scale, on part drawing sheet to simplify part programming task. Conducts tooling analysis of part from engineering drawing with consideration of machine tool jigs, fixtures, and cutters. Locates and describes "0" coordinate position (origin) to facilitate calculation of coordinate work positions. Designates clamp, pin, and unload positions by applying knowledge of N/C machining practices. Assigns position numbers to each location

Analyst C. P. Campbell Reviewer C. P. Campbell

where machining operations are to be performed and to unload position. From tooling analysis, identifies cutting tools needed to manufacture part, assigns each tool a number and records tool number and name in columns provided on part drawing sheet. Develops tool path sketch to plan milling procedures and assure clearances when part is machined. Converts fractional and decimal data on engineering drawing to absolute dimensions by using mathematics at levels of arithmetic, geometry, and trigonometry, when conventional rather than coordinate dimensions are used by workpiece designer. Calculates and records coordinate values for each position number in columns provided on part drawing sheet. Uses Calculator or Computer Terminal to simplify computational tasks. (2-22%)

3. Prepares part program manuscripts: Plans sequence and nature of machining operations and procedures utilizing familiarity with capabilities and limitations of specific numerically controlled machine tools and knowledge of shop practices and physical properties of materials. Writes N/C machining programs for all types of machined parts by preparing N/C manuscript listing the location of reference and transition points and the commands to move cutting tools through operations. (2-36%)

   a. Prepares part program manuscript for discrete positioning, point-to-point machines: Writes detailed sequential statements of each machine command, such as position, general instructions to machine, numeric value of all operations, auxiliary and miscellaneous functions and operation instructions manually, using specialized coding symbols, and alpha-numeric characters, utilizing familiarity with capabilities and limitations of specific N/C point-to-point machine tool such as Machining Center and horizontal boring and milling machine and knowledge of shop practices and physical properties of materials. Uses part drawing to specify location and orientation of workpiece and fixturing, and other factors such as tool position and/or path and dimensional tolerance, data, feed-rates and speeds, size and type of cutting tools, movements of machine table, and programmed machine stops for loading and unloading, inspection, or tool changes. Uses calculator or computer terminal in order to simplify computation tasks. Defines operator instructions, and prepares separate, abbreviated operator manuscript, when detailed process sheets are not used on machine floor. Reviews completed part program manuscripts prepared manually by self, or crosschecks those of others, to detect and correct errors. Routes hand written manuscript to clerical personnel to be encoded into the control medium, punched tape, magnetic tape or a deck of data processing cards, used to control the N/C machine tool. The most popular medium being perforated tape because of economy and simplicity of

operation. Reviews returned hard copy, and cross-verifies with original manually prepared manuscript, in final effort to detect and correct part programming and processing errors before release to manufacturing group. Reads trade literature and participates in professional organizations to keep informed on developments and improvements in equipment, processing and manufacturing techniques.

b. Prepares part program manuscripts for continuous path, contour machines: Analyzes specific problem, plans part from engineering drawing and writes part program manuscripts in appropriate part programming language on coding sheets to define setup, tooling and operation of continuous path N/C machine tools such as profiling and die-sinking milling machines, by applying knowledge of mathematics, machining methods and practices, familiarity with specialized computer-aided continuous path part programming languages and Digital Computer operation. Develops a computer language manuscript by writing a series of English-like symbolic and numeric statements that describe workpiece by its geometric components and their relative position in the Cartesian coordinate system. Identifies on coding sheet the part, post processor to be used, machine control unit (MCU), N/C machine and control functions such as tooling and feedrates. Defines all needed lines, points, circles, ellipses and surfaces in the computer language; describes the path of the cutting tool in computer language and miscellaneous commands. Routes hand written part program manuscript to Key Punch operators to be encoded into the control medium, a deck of data processing cards. Reviews returned print out and data processing cards and cross verifies with original manually prepared manuscript to detect and correct part programming and processing errors (See comments). Routes data processing cards to computer operator for computer processing and preparation of machine control media, perforated tape, magnetic tape or a complete deck of data processing cards, used to control the N/C machine tool. The most popular media being perforated tape. Examines machine control tape and computer print out to identify and correct processing errors before release for tooling and manufacturing. Devises test programs and makes recommendations for improving computer techniques. Reads trade literature and participates in professional organizations to keep informed on developments and improvements in equipment, processing and manufacturing techniques for automatic machine-tool programming on electronic general purpose digital computers.

4. Occasionally operates Tape Preparation Machine: Reproduces information from part program manuscript by typing it on a tape

preparation machine, which has a typewriter keyboard, tape punch and reader, by operating unit manually through the keyboard in the same manner as a standard electric typewriter, simultaneously causing a perforated tape and hard copy to be prepared. Visually compares typed hard copy with original manually prepared part program manuscript in effort to detect processing errors. Prepares duplicate machine control tapes for filing and/or use by additional N/C machines by threading original perforated control tape into tape reader, activating appropriate buttons manually and causing tape punch to produce duplicate perforated tape and/or hard copy automatically. Verifies second tape by comparing existing tape with characters being punched while tape preparation machine automatically types a duplicate tape and/or hard copy. When necessary, corrects perforated tape, deletes or includes added or revised information on control tape by punching out separate section of tape and splicing into original control tape. (1-5%)

5. Occasionally operates key punch machine: Copies information from part program manuscript written manually in programming language, by keypunching it into a deck of data processing cards. Activates keypunch with power on switch located on lower front of machine. Flips the print function control switch to on position and auto feed switch to off position. Places cards in card hopper located on upper right hand side of machine by pinching together release lever and backplate, pushing backplate of hopper toward back of machine and inserting cards face toward the operator. Positions a card for punching by depressing feed key then registration key to register the card at punching station. Punches cards and simultaneously prints characters by using keyboard like a typewriter. Pushes release key to release card under punch station transporting it to reading station then on to stacker, so that it may be removed from the machine or a new card registered. Continues procedure until finished, then removes cards from card stacker. Cleans up machine and surrounding area, normally leaves machine on. (1-less 5%)

6. Occasionally operates various numerically controlled machine tools: Sets up and operates N/C machine tool under programmed tape or card instruction by applying knowledge of machining practices, metal-working procedures and N/C concepts. Studies detailed, written operator instructions on part program manuscript and part drawing to understand setup and operating requirements. Selects and mounts specified holding fixture to table and loads part or workpiece into fixture using specified blocks, risers, and clamps. Loads and secures tooling in machine spindle or turret, sets depth stops, cams, and dial type switches as indicated by operator instructions. Loads control tape reel or loop in MCU cabinet and threads tape through tape reader. Sets switches and dials on MCU to select mode of operation and initiate machining operations. Monitors cutting action in addition to position and sequence number display lights on MCU panel and compares with data on part program manuscript to verify machine operations. Changes tooling when called for or when worn. Verifies machining accuracy by visually inspecting each cut and by using scales, gauges, and micrometers to compare

workpiece specifications with those indicated on part program manuscript and part drawing. Applies independent judgment and knowledge of metalcutting practices to override tape controlled machine functions. Keeps record of deviation from programmed operations when minor machining problems are encountered and shuts down machine in event of machine error or malfunction. Operates machine in dial-in or manual mode, when necessary. Removes and replaces workpiece at end of machining cycle. (1-5%)

7. May observe tape verification on N/C machine: Verifies unproven N/C control tapes for accuracy by proofing in shop. Reviews performance of machine, without cutting tool in spindle, against process sheet information and data from visual display indicators on MCU in order to detect errors. Observes test run on first piece for final debugging, if necessary, to assure adequacy of part program before production (2-less 5%)

8. May operate N/C Drafting and/or Plotting Machine: Verifies N/C control tapes for accuracy before their release to manufacturing group for production, by running control tape through N/C drafting-plotting machine director and reviewing graphic output of workpiece profiles and paths of cutter centerlines (See comments). (1-less 5%)

9. May operate N/C Digitizing Machine: Prepares perforated control tapes with a digitizer by sensing points on existing engineering drawings, part models, patterns or loft plates and converts these points to numerical data on tape or other medium for input to N/C drafting machines and N/C machine tools. Places model, etc. on stage of probing unit, mounts suitable probe in probe carrier and causes probe to follow desired contours or position over desired points. At appropriate or designated point, probe is stopped and the coordinates, which are continuously displayed on the readout, are punched into the tape and registered on the printout by depressing a key or floor treadle actuator switch. This procedure eliminates hand written part program manuscript, a major source of human error in production of punched control tapes. (1-less 5%)

10. May operate Computer-Aided Design Machine: Designs parts for manufacture by N/C via the computer by drawing lines on input device, cathode ray tube, with phototlectric light pen. Presses buttons and keys to define design intent, modify portions of design and specify dimensions. Processes design through large general purpose digital computer which receives, converts, calculates, analyzes, and permanently records design information in computer memory or in a form suitable for operating N/C drafting machines and machine tools. (2-5%)

11. May specialize in particular type of part programming: Designated by employer according to type of or group of related machine tools for which preparing parts programs or by trade mark or single make of machine tool or MCU for which programs are prepared. Specializes in developing part program manuscripts in particular control language format or computer-aided part programming language and may be designated according to this specialization. (2-less 5%)

12. May conduct training in N/C: Coordinates all required training, organizes and develops training materials and instructs. Conducts formal and on-the-job training to employees and/or customers in part programming, operation of various N/C machines and equipment maintenance. Advises management on outside training of most value to personnel. (2-6%)

13. May make recommendations on improvement of N/C systems and coordinate equipment acquisitions: Analyzes N/C machines on hand by checking performance, productivity and versatility and makes suggestions to management on improving systems. To keep operation competitive, assists management in long-range planning for N/C utilization by projecting future equipment needs and investigating available hardware to meet these needs. Evaluates performance capabilities and cost and justifies expenditure showing probable return on investment and time required for "payback". Coordinates acquisition of new equipment by developing equipment specifications, inspecting vendor bids, conducting pre-delivery get ready and supervising installation and "customer acceptance test". (2-less 5%)

14. May act in liaison with maintenance department and other specialists: Develops maintenance and production methods by working in liaison with specialists in maintenance, quality control, etc. Develops maintenance schedules after referring to equipment manufacturers' specifications and consulting with specialists in the area, to reduce breakdowns and machine errors. (2-less 5%)

15. May develop or refine time and cost data: Develops as a by-product of part programming, time studies and cost analysis, manually or with the aid of computer, to improve scheduling, cost control and machine justification, and eliminate duplication of effort by industrial engineering department. (2-less 5%)

16. May assist management in job evaluation and wage administration: Sets wage and salary standards after job evaluation and comparison with industry-wide rates. Resolves labor disputes by investigating grievances and making decisions based on knowledge and background (See comments). (2-less 5%)

PERFORMANCE REQUIREMENTS

6. Responsibility

Is responsible, under limited supervision, for a variety of activities such as resolving questions of design intent, determining suitability and availability of standardized tooling and fixturing, analyzing alternative part programming methods and machining sequences, and reviewing computer output during the course of a single assignment. Responsible for making decisions on a judgmental basis using past experience and knowledge to select the best part programming techniques, sequence of machining cycles and incorporating portions

of previously prepared part programs without trying out alternative methods, thereby reducing time and cost of preparing manuscripts. Responsible for making decisions on a factual basis, such as when assigning feedrates and speeds previously found to provide optimum balance of such factors as accuracies and surface finishes, machining time, and tool life. Utilizes accepted standards in recording processing statements in specialized part programming formats and languages. Adheres to standardized nomenclature when preparing setup instructions for operators and in complying with established machine feedrates and speed conventions. Responsible for providing close supervision and guidance when training workers in the programming, use, operation, and maintenance of N/C machines and peripheral equipment. Responsible to management for technical assistance in long-range N/C planning including time studies, cost analysis, job evaluations and recommendations for the acquisition of new equipment.

7. Job Knowledge

Must have numerical ability at the level of shop arithmetic, geometry, trigonometry, analytic geometry and calculus to comprehend functions of N/C systems and prepare part programs, along with non-decimal arithmetic and Boolean algebra to comprehend functions of N/C system, read and interpret machine control tapes and MCU display lights. Mathematics at the level of vector analysis is required to select from alternate part programming methods, and achieve optimum balance of part programming, computer processing and machining time. Must have spatial ability to visualize raw and finished parts from engineering drawings, sketches and mathematical descriptions, avoid tool collisions, envision detailed sequence of machining cycles that will produce the part most efficiently and produce tool lay-up and setup sketches. Must be able to record data accurately and use a calculator and computer terminal for computational tasks. Must be able to read and understand engineering drawings, have a thorough knowledge of jig and fixture design, properties of metals, general shop and machining practices and a complete familiarity with N/C systems and methods of production. Must be able to learn specialized symbolic part programming languages and prepare written instructions for workers in areas of tooling, fixturing, and machine setup and operation. Must be able to utilize and/or operate N/C machine tools, digital computers, key punch machines, tape preparation machines, N/C drafting machines, plotting machines, digitizing machines, inspection machines, and computer-aided design machines. A working knowledge of the basis principles of physics and engineering is required. Must have understanding of what engineering and design information are and how they can be most effectively communicated to people and computers. Must know how to use precision measuring instruments, such as dial indicators, vernier calipers, micrometers, and the like.

8. Mental Application

Must take initiative to confer with design, engineering and operating personnel about difficulties in design interpretation, part programming, machining and maintenance. Must be able to plan and write concise,

unambiguous part program commands and operator instructions. Must be mentally alert and able to form clerical perceptions, to visualize pertinent details, distinguish symbols on drawings and sketches, and to identify, record, and verify numbers, letters, words and special symbols that make up the machine commands of the part programming language. Must be able to coordinate planning, and decide method and sequence of operations by which parts are to be manufactured. Must be constantly alert to avoid errors in planning, programming and manufacturing parts by N/C. Must be alert to possible errors in engineering drawings. Must use professional judgment in preparing part drawings, tooling analysis and part programming manuscripts for product manufacturing.

9. Dexterity and Accuracy

Must have good visual acuity and coordination of sight to analyze engineering drawings. Must be able to discriminate accurately between alphabetical, numerical, and special symbols in order to record them correctly and in sequence on work sheets and manuscripts. Must be able to read technical sketches, conventional and mathematical-analytical design data with absolute accuracy to determine steps and method of manufacture by N/C. Must use extreme care and a high order of manipulative dexterity in preparing part drawings and part program manuscripts. Must be able to set up and utilize various N/C machines and peripheral equipment with considerable care and dexterity to obtain accurate results.

COMMENTS

10. Equipment, Materials, and Supplies

Equipment:

Computer Terminal: Teletype Model 35 ASR (automatic send-receive), manufactured by the Teletype Corporation, 5555 Touhy Avenue, Skokie, Illinois 60076.
A machine used for N/C control tape preparation for machine tools and/or drafting machines in addition to direct access to time-sharing computer service and other business machines. The model 35 features a keyboard, a printer, a paper tape punch, and a paper tape reader. These can be used in various combinations within the machine and to send to and receive from remote equipment. It has a 4-row keyboard similar to that of a regular typewriter. The letters, numbers, and certain punctuation marks are generated by pressing the appropriate keys. The printer has a friction feed or sprocket fed platen for 8 1/2 inch paper. The tape punch receives and recognizes information in the form of serial signals emanating from the signal line of the local set of from distant transmitting equipment. It fully perforates an 8-level, 1 inch tape in EIA, RS-358 (ASCII) code. Operating in conjunction with or independent of the other components, the reader senses the data stored on the punched tape and generates corresponding serial signals to send the data on to activate the printer and prepare a hard copy print out.

Calculator: Friden Model STW, manufactured by Friden, 31 Prince Street, Rochester, New York 14607.

A fully automatic calculating machine for performing the basic mathematical operations of addition, subtraction, multiplication and division. The machine consists of two keyboards, a carriage and many specialty dials, stops, keys and bars.

Digital Computer: PDS 1020, N/C System General Purpose Digital Computer, manufactured by Pacific Data Systems Inc., 185 Mammouth Parkway, West Long Branch, New Jersey.
Used to execute stylized procedures or programs, for solving such diverse problems as probing outer space, preparing checks and planning cities. They are used by problem solvers throughout government, business, industry, and education. The five main functions of a computer are:

1. input
2. storage
3. control
4. processing
5. output

Although there are many types of general purpose digital computers, their differences lie in speed, cost, or convenience to user, not in their logical power. From the viewpoint of the user, the machine manipulates two basic types of information:

1. operands or data
2. instructions, each of which usually specifies a single arithmetic or control operation and one or more operands which are the objects of the operation.

Within the machine, both instructions and data are represented as integers expressed in binary code. The heart of a general purpose digital computer system is the central processing unit comprised of: main storage, which holds both program and data; arithmetic logic unit, which contains processing circuitry such as an adder, shifter; and registers for holding the operands and instructions currently being processed.

Key Punch: IBM Key Punch. The most common means of recording information into punched cards. The operator transfers data into cards by an operation very similar to typewriting, frequently called "keypunching". Data being punched may also be printed at the top of the card. Basically, there are three types of card punches available: the 24, 26, and 29 card punches.

Machining Center: Cincinnati Cintimatic 2-Axis Vertical Machining Center, manufactured by the Cincinnati Milling Machine Company, Cincinnati, Ohio 45209.
A machining center is a versatile N/C machining system capable of automatically performing all the operations necessary to completely machine a wide variety of parts from start to finish. "Machining Center" has developed into a generic term used to describe almost any complex numerically controlled machine which is a combination drilling, boring and milling machine. Originally, the term was coined to describe a tape controlled machine with these three attributes:

1. It must drill, bore, mill, tap, counterbore, countersink and perform all operations on a part normally accomplished by the use of rotating cutting tools.

2. It must present at least four sides of the part to the cutting tools, preferably all sides.
3. It must have the capability of automatically selecting enough tools from a tool storage rack, turret or drum to machine a part completely.

So, basically a machining center originally had to have boring, drilling and milling capabilities and machine at least four sides of a part by selecting tools through an automatic tool changer. Machining centers available today are capable of performing such operations as boring, drilling, reaming, tapping, counterboring, countersinking, and milling multiple faces of the part on one machine with a single set-up of the workpiece. They are equipped with means for automatic tool changing and for controlling all aspects of the machining process, such as positioning, spindle speed, feed rate, and coolant on and off. For this reason, the machining center, actually a new concept of manufacturing, has no single counterpart among conventional machine tools.

Numerically Controlled Digitizing Machine: Auto-trol Digitizer, manufactured by the Auto-trol Corporation, 6621 West 56th Avenue, Arvada, Colorado 80002.
Digitizing machines were developed to perform functions in opposition to those of drafting machines. In general, the purpose of digitizers is to sense points on drawn or scribed lines on existing drawings or patterns (instead of drawing them), and convert those points to numerical data on a paper tape or other medium. These data then can be further processed by a computer, or used directly to control machine tool movements. Thus an engineering drawing, pattern, loft plate, or similar object placed on the machine table can be the input medium. After the operator zeros in the sensing device--with a built-in microscope on the machine, or by using a console with a closed circuit television display--he can instruct the machine to follow the rest of the line or curve by depressing console keys. On some machines he can also add instructions, such as coolant off-on commands and machine tool feedrates through the keyboard, to produce complete machining tapes, rather than tapes that merely define the configuration of parts to be machined. Until now, the major market for digitizing machines has been the aircraft and aerospace industries. However, development of more sophisticated and flexible digitizing systems may change this situation rapidly. Now on the market, for example, are machines capable of both digitizing and drafting functions, with moderate change-over time required of the operator. These machines are becoming recognized by management in many industries as very desirable; they add to manufacturing flexibility, and at a cost that is feasible.

Numerically Controlled Drafting Machine: Orthomat Mark II, built by Universal Drafting Machine Corporation, 5200 Richmond Road, Bedford Heights, Ohio 44014; Gerber Graphic Display System, built by Gerber Scientific Instrument Company; and Kingmatic Drafting Machine, built by Baldwin Kongsberg Company.
An automated device used to record digital computer output in graphic form. N/C drafting machines are used either directly connected to a general-purpose digital computer or off-line and use computer

output, usually in the form of punched cards or magnetic tape, as an input medium to provide a graphical representation of the computer operations. The basic N/C drafting machine is of gantry type construction with special servomotors driving the "Y" beam carriage and plotter head over the drafting surface. The drafting surface may be equipped with a vacuum chucking system to hold the drawing media. A console unit separate from the drafting table interprets the instructions from punched tape or manual input data and controls the drawing and printing of the proper lines and characters. The plotter head has a single or automatic indexing turret mechanism for mounting a variety of styluses such as pencils, pens, scribing tools, prick punch and in some systems a separate print wheel for alphabetic information or a photographic device to expose film. (See task 8, in item 12, General Comments, for additional details).

Numerically Controlled Machine Tools: MOOG HYDRA-POINT 3 Axis N/C Machine and MOOG Model 83-200 HYDRA-POINT N/C Machine. The primary difference between N/C machine tools and conventional or automatic machine tools lies in the method of supplying input data to the machine and obtaining feedback signals. With N/C, automatic operation is achieved by means of numerical instructions coded on tape. These instructions, prepared in advance by a part programmer and recorded on tape, can control the sequence of machining operations, machine positions, spindle speeds and rotational direction, distance and direction of movement of the tool or workpiece, coolant flow, table indexing and tool selection. The punched tapes are placed on the MCU which consists of a system of electronic interpreting devices, and when activated, guide the machine tool through the programmed commands with little or no human intervention. N/C machine tools are faster, more accurate, and more versatile than conventional or automatic machine tools where complex shapes are to be machined, and where otherwise many manual operations would be required.

Numerically Controlled Plotting Machine: Cal Comp Digital Incremental Plotter, manufactured by California Computer Products, Inc., 305 N. Muller Avenue, Anaheim, California 92803.
Plotting machines are quite similar in concept and operation to N/C drafting machines. The differences are primarily in the degree of accuracy and quality of the drawings that can be produced, and in the method of drawing. This type of digital plotting device has one axis of motion provided by a rotating drum. Plotters which are cheaper, smaller in size, and less sophisticated, are used more widely at present than the drafting machines. Bidirectional stepmotors are employed by plotters for both the "X" and "Y" axes. The plotting is regulated by the movement of a pen relative to the surface of the coordinate paper, with each input pulse causing a step of either 0.01 or 0.005 inches. The "X" axis deflection is produced by motion of the drum and the "Y" axis deflection is produced by motion of the pen carriage. Electrical signals raise and lower the pen from the surface of the paper. All plotting, discrete points, continuous lines (straight or curved), or symbols, is accomplished by the stepping action of the drum and carriage. Digital incremental plotters can be used on-line with most general purpose digital computers through an adapter which converts the computer output signals to a form suitable for driving the plotter. For off-line operation the

plotter may be combined with a magnetic-tape-storage and readout unit to provide a complete tape plotting system. Paper alignment is maintained by sprockets on the "X" axis drum. Various types of translucent and vellum papers are available in roll stock either 12 or 31 inches wide, depending on the drum sprocket width. The plotter has been used for verifying N/C control tapes, plotting weather maps, lofting in aircraft and ship design, highway construction (cut and fill problems), telemetry-data plotting, stress analysis studies and critical path scheduling for construction projects.

Tape Preparation Machine: Teletype Model 33TZ ASR; Strippit Tapetyper Number 80151-000; Dura Mach 10B, 15" Model; and Friden Flexowriter Model 2301. These tape preparation machines have typewriter keyboards, an integral tape punch and reader (code sensing device). They are operated manually through the keyboard in the same manner as a standard electric typewriter. In N/C applications, the operator reproduces the information from the hand written part program manuscript; this operation simultaneously causes a punched tape and hard copy to be prepared.

Materials:

None

Supplies:

Blueprints and/or whiteprints

Books and manuals

Data processing cards

Drawing instruments

Magnetic tape (computer input/output medium)

Paper

Part drawing work sheets

Part program work sheets

Pencils and erasers

Scales - architects and engineers

Specifications sheets

Tape splices (N/C machine control medium)

Machine control tapes (perforated tape) in various types of materials

- Mylar
- Mylar/Aluminum Foil/Mylar
- Mylar/Metalized Mylar

Paper - oiled and unoiled

Paper/Mylar/Paper - oiled and unoiled

11. Definitions of Terms

ABSOLUTE DIMENSION - (See also COORDINATE DIMENSION WORD) - A A dimension expressed with respect to the initial zero point of a coordinate axis.

ALPHANUMERIC CHARACTERS - A code system in which the characters used are the letters of the alphabet and the numerals 0 to 9.

CARTESIAN COORDINATES - A means whereby the position of a point can be defined with reference to a set of axes at right-angles to each other.

CONTOUR CONTROL SYSTEM - A system in which the path of the cutting tool is controlled by a simultaneous, coordinated movement of two or more axes.

COORDINATE DIMENSION WORD - A word defining an absolute dimension with respect to a specified referenced zero.

DIGITAL COMPUTER - A computer that uses discrete numbers rather than physical quantities in processing data.

MACHINE CONTROL UNIT (MCU) - Sometimes referred to as the CONTROLLER, or DIRECTOR. This is the brains of the numerical control system. It consists of a tape reader plus the electrical and electronic equipment needed to change the tape codes into machine commands. The MCU contains the memory, computational abilities, and relatively simple switching circuits as needed for simple or complex machines. The machine operator's controls and indicator lights may be mounted on this unit, or all or part of these controls may be contained in a separate console.

MAGNETIC TAPE - Tape made of metal or plastic, coated with a magnetic material, upon which can be stored programmed information.

NUMERICAL CONTROL SYSTEM - A system where the actions are controlled by the direct insertion of numerical data at some point. The system must automatically interpret at least some portion of the data.

PERFORATED TAPE - Tape in which a pattern of holes and a tape feed hole have been punched in a row, so as to convey information.

POINT-TO-POINT CONTROL SYSTEM - See POSITION CONTROL SYSTEM.

POSITION CONTROL SYSTEM - A discrete or POINT-TO-POINT CONTROL SYSTEM in which the controlled motion is used as a means of reaching a given end point with no path control during the movement from one end point to the next.

POST PROCESSER - A computer program which converts the generalized output of a computer-processed part program into the specific input requirements of the machine tool-numerical control system on which the part is to be machined.

PUNCHED TAPE - See PERFORATED TAPE.

12. General Comments

Work Performed: The tasks in this job analysis schedule have been compiled from a number of different sources and therefore describe the job in a generalized composite form. Consequently the description may not coincide exactly with a specific job in a particular establishment.

Task 1: Significant attempts are being made to design products specifically for manufacture by numerical control. Manufacturing feasibility and cost analysis play a major role in the definition of optimum designs. The leaders in this effort include aircraft, aerospace and ordnance industries. Many employers are insisting that their design engineering personnel acquire a knowledge of numerical control processes, as well as machine capabilities and limitations. Thus, an increasing proportion of their new-products mix is being designed to take full advantage of the numerical control potential.

Task 3b: Part programming personnel often use computer part programming languages (such as APT) but are not required to know all the details of how a computer functions, its logic and arithmetic units, and its capabilities and limitations. However, the computer programmer for numerical control must be familiar with at least one make and type of digital computer, and must meet most of the requirements of a part programmer, in order to be able to prepare or modify numerical control computer programs effectively. Thus, to be effective, any computer programmer for numerical control must be competent as an engineering and scientific computer programmer, and must have acquired a fairly extensive background in machine shop practices, machining properties of materials, and machine tool and control capabilities. The ability and experience to perform adequately in only one of the two areas is just not enough. The job is inter-disciplinary in nature.

Task 8: Automatic drafting machines, basically X-Y plotters, but sophisticated, often large in size, and capable of high accuracy and rapid recording speed, are coming into use in the aircraft, automobile and aerospace industries to record digital computer output in graphic form. Exploratory work on the N/C drafting machine began in 1947, but it was not until 1956 and N/C profiling, that nonmanual data inputs were available. Early attempts at N/C drafting employed an N/C profile miller (using a 20-hp. spindle to grip a small scriber) to produce drawings. Even with this massively inappropriate equipment, cost savings were demonstrated and time saved. Today more sophisticated machines designed with drafting or plotting as their primary function do the routine work 20 times faster, more accurately and with less lead time than manual methods. Some machines can scale up and down, to produce drawings to the exact scale desired.

Probably the major use of most drafting machines is in verifying the accuracy of tapes before they are released for production, but there are many other applications such as pattern and template scribing, plotting, aircraft and ship lofting, mapping, surveying problems and straight drafting. The last of these may eventually have the greatest effect on personnel employed in the drafting occupations. Some of the machines now being marketed not only can develop three-view line drawings, but also have full alphabetic and numerical printing capabilities and thus can produce supporting data on drawings. However, as is the case with almost all new hardware, it probably will be some time before procedures to realize the full potential of the equipment are completely developed and appreciated. (See item 10, Equipment, for description of machines).

Task 16: Workable programs of formal job evaluation and wage administration in the area of numerical control operations have proven difficult to set up. One reason has been the tendency of employers to develop job evaluation systems based on machine functions, rather than job requirements. This is understandable because early steps are often tentative, with machines frequently acquired one or two at a time. Numerically controlled machine tools are commonly spotted, at least initially, in general machining areas, with the location often determined by the function and size of conventional machines they replace or augment. As a result, some fundamental differences in job requirements tend to be overlooked or understated. Physical effort requirements changed markedly with numerical control. Machine positioning in at least two axes of movement becomes a tape rather than manual function. But setup and takedown are more frequent because of high machine productivity, and as manufacturing planning for numerical control becomes more experienced, the operator could find it increasingly difficult to stay ahead of the machine. One of the most difficult conventional job evaluation factors to apply to numerical control is that of responsibility. Many of the duties and tasks previously assigned to the operator of a conventional machine tool--and his shop supervisor--have been transferred to the engineering department. Details of operator duties, and their sequence, are specified for him on operator manuscripts. Other functions of conventional machine operators now are a series of coded machine instructions. They are on the tape. But where does the final responsibility lie? Is the operator to be held accountable for workpiece quality, and will he be expected to notice machining problems, and either override feeds and speeds or notify his supervisor? Who is to be responsible for adequate tool life--the operator, the foreman, or the engineering department? In all cases, the operator is expected to remain alert, and try to shut down the machine in time to prevent major damage, when there is a control malfunction or part programming error. But is he required to anticipate problems such as those arising from variations in raw workpiece size, and trim the controls to prevent machining difficulties? As yet, there are no absolute answers to many of the administrative difficulties presented by numerical control. Patching conventional job evaluation and wage systems to adjust to numerical control has not proved adequate, and an increasing number of employers are now setting up entirely separate classification structures and standards for numerically controlled machine operating jobs. Numerical control already has considerably changed hiring standards, it's a new breed of cat, and to a certain

extent so are its operators. Man-machine relationships are fundamentally changed. Numerical control has also forced changes in functional organization, as major users begin to view it as an entirely new manufacturing system, and not just as strange looking, expensive, and somewhat frightening pieces of hardware. Just as numerical machining has changed the content and interrelationships of jobs in manufacturing, it may compel fundamental improvement in design and operation of company wage systems. Questions--and major issues--are being raised both by management and labor, and current techniques of job evaluation and wage administration may not be good enough to provide the answers.

APPENDIX B

JOB ANALYSIS SCHEDULE
LUBRICATION MAN (VEHICLE)

JOB ANALYSIS SCHEDULE

1. Job Title LUBRICATION MAN (VEHICLE)
2. Date 8 September 1975
   Number of sheets 5
3. Alternate titles LUBRICATION TECHNICIAN; LUBRICATOR; INSIDE QUICK SERVICE SPECIALIST
4. Dictionary title and code LUBRICATION MAN 915.887

5. Work Performed

Lubricates bearings, bushings, and gear boxes with a hand operated grease gun, hand operated gear lubricant dispenser, oil can, squirt can, and stick lubricant in accordance with the shop work order and manufacturers' specifications to reduce wear and extend the useful life of a vehicle.

1. Prepares vehicle for under chassis lubrication: Drives vehicle into service area, positioning over Twin Post Hydrolic Pneumatic Lift by steering wheels of vehicle into guide depressions in garage deck, stopping when seated. Examines shop work order received to determine the kind and extent of lubrication required. Examines the manufacturers lubrication specifications chart for the particular make, model, and year of the vehicle to be lubricated. Manually adjusts lift arms at front of vehicle to a position under spring assembly, and at rear under axle housing. Hoists vehicle 1 to 2 feet above deck on twin post hydrolic pneumatic lift with compressed air controlled by hand operated control levers located on lift control panel. Visually examines lift arms for correct positioning. Repositions lift arms when necessary, for safety and to prevent damage to vehicle, by lowering lift to deck for manual readjustment of lift arms to correct points. Raises vehicle to work height by hand operated lift control levers for under chassis inspection and lubrication. Examines by visual inspection, underside of vehicle for obvious existing hazards, ex.: worn or damaged tires, faulty exhaust system, frayed emergency brake cable, damaged hydraulic brake lines, oil leaks, damaged shock absorbers and missing fasteners. Reports defects or malfunctions to supervisor. (3-10%)

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2. Lubricates under chassis: Locates and wipes clean all zerk fittings in steering knuckles and universal joints with a rag, to keep foreign material from entering joint with lubricant. Forces chassis grease into all such fittings with a hand operated Grease Gun by snapping female nozzle fitting over each male zerk fitting and manually pumping grease gun lever until old grease is visually observed seaping from the grease joint. Locates standard transmission inspection plug and wipes clean with a rag for proper wrench seat. Removes plug from transmission housing using an Open End Wrench by unscrewing plug in a counterclockwise direction. Inspects visually transmission oil level by gauging it in reference to full level, adds multipurpose gear lubricant from a hand operated Gear Lubricant Dispenser, when necessary and replaces inspection plug using wrench by threading in clockwise direction. Locates differential inspection plug and wipes clean with a rag for proper wrench seat. Removes plug from differential housing with an open end wrench by unscrewing plug in a counterclockwise direction. Inspects visually differential oil level by gauging it in reference to full level, adds multipurpose gear lubricant from a hand operated gear lubricant dispenser, when necessary and replaces inspection plug with wrench by threading in clockwise direction. Lubricates shock absorber mount bushings and rear spring mount bushings with a hand operated Squirt Can by spraying rubber lubricant on and between moving surfaces to reduce wear and quiet squeeks. (2-40%)

3. Drains engine oil: Wipes clean crank case drain plug with a rag for proper wrench seat. Positions Waste Oil Container under crank case drain plug and manually adjusts height of funnel to receive waste oil flow. Removes crank case drain plug from housing with a Hex Head Wrench by unscrewing drain plug in counterclockwise direction, allowing oil contained within to drain into waste oil container. Replaces drain plug in crank case housing, when oil flow has ceased, with a hex head wrench by threading clockwise until snug. Removes waste oil container from under crank case to storage position for future use. (2-10%)

4. Changes engine oil filter: Locates and examines engine oil filter carefully to determine the type of filter needed for replacement and the procedure to be followed. (2-15%)

   a. Changes engine oil filter, canister type: Removes filter element canister from seat with engine block by unscrewing in a counterclockwise direction with a Snap Wrench. Discards entire filter in proper container and replaces with new filter element canister by threading in a clockwise direction, by hand, until snug with seat on engine block.

   b. Changes engine oil filter, element type: Loosens center bolt in filter housing with a hex head wrench by unscrewing in a counterclockwise direction. Removes center bolt and filter housing cap, pulls out filter element and discards in proper container. Cleans inside of housing with rags and inserts new filter

element. Replaces rubber gasket in filter housing cap, and positions cap over filter housing. Inserts center bolt through cap and threads clockwise with a hex head wrench until snug.

5. Occasionally packs front wheel bearings: Removes wheel cover from wheel rim by prying with a Screw Driver between wheel cover and wheel rim until loosened. Removes wheel bearing grease retainer with Channel Lock Pliers by alternately applying an up and down movement on cap and an outward force, removes cotter key from wheel bearing retainer nut with Diagonal Pliers by grasping eye of cotter key and prying from castellated nut. Unscrews nut from axle spindle in counterclockwise direction by hand. Removes bearing retainer washer and outer wheel bearing from spindle manually, removes wheel from spindle, positions wheel outside face up over cardboard, drives inner wheel bearings and bearing oil seal from wheel by striking a Drift with Machinist's Hammer. Cleans bearings with a rag, places bearings on bearing packer, packs with new grease until old grease is forced out, cleans wheel bearing races with a rag, replaces inner bearing and oil seal retainer by driving into wheel with soft face Mallet. Mounts wheel on axle spindle, replaces outer bearing and bearing retainer washer, replaces wheel bearing retainer nut by threading in a clockwise direction with an open end wrench until tight, backs off bearing retainer nut one counterclockwise turn for proper seat. Installs cotter key through castellated nut and axle spindle, splits ends to secure. Replaces wheel bearing grease retainer into position by tapping with a soft face mallet. Replaces wheel cover over wheel rim by tapping along outer rim with a soft face mallet. (3-5%)

6. Prepares vehicle for under hood lubrication: Lowers hoist by exhausting compressed air controlled by hand operated levers located on lift control panel. Removes lift arms from positions under vehicle by manually pushing them to a central resting place on the lift frame. Raises hood of vehicle by releasing spring-catch under front of hood, and guide to open position. (2-less5%)

7. Lubricates under hood: Locates and wipes clean steering column lubrication oil plug, with a rag. Removes oil plug from housing using an open end wrench by unscrewing plug in counterclockwise direction. Inspects visually oil level in reservoir by gauging it in reference to full level and adds multi-purpose gear lubricant to reservoir when necessary. Replaces oil plug using wrench by threading in clockwise direction until snug. Lubricates distributor at capilary shaft oil cup with general purpose oil by filling oil cup from hand operated oil can. Lubricates alternator at shaft bearing oil cup when provided, with general purpose oil by filling oil cup from a hand operated oil can. Removes storage battery filler caps from battery case by unscrewing caps in counterclockwise direction by hand. Inspects visually electrolite level by gauging it in reference to full mark in filler neck and adds distilled water when necessary. Replaces filler caps by

hand threading in a clockwise direction. Removes engine oil dip stick, by withdrawing, by hand, from tube leading to crank case, wipes dip stick clean with a rag, inserts full length of dip stick into tube, removes and inspects visually oil level on dip stick. Replaces dip stick and adds appropriate engine oil to maintain full system. Removes radiator filler cap manually by rotating 90° counterclockwise, visually inspects coolant level in expansion pan, adds water or coolant until full and replaces filler cap manually by rotating 90° in clockwise direction. Cleans brake master cylinder filler cap with a rag, removes filler cap, visually inspects brake fluid level in master cylinder reservoir by gauging it in reference to full mark. Adds appropriate brake fluid to reservoir until full and replaces filler cap. Cleans or replaces carburetor air filter by unscrewing wingnut located in top center of filter case, by hand, removes filter case lid for access to filter unit. Replaces, or cleans filter in solvent and dries with a jet of air from air line. Inserts filter into case, replaces lid and threads wingnut by hand in a clockwise direction until snug. Cleans oil filter cap by removing from filler pipe and emersing in solvent. Dries with air from air line and replaces in filler pipe. (2-10%)

8. Lubricates doors: Applies general purpose oil to hinge pin and receiver assembly with a hand operated oil can, cleans excess oil with a rag. Applies stick lubricant to door lock mechanism by rubbing a film on door lock striker plate and latch. (1-less 5%)

9. Completes shop work order and service sticker: Writes appropriate entries on shop work order for all work completed, lists any discrepancies or unusual circumstances, completes service sticker and attaches to door frame. Removes vehicle from hoist to parking area by driving. (2-less 5%)

10. Re-fills lubricant dispensers and maintains tools and work area: Fills containers such as grease gun, gear lubricant dispenser, oil and squirt cans with specified lubricants. Cleans tools and equipment, then returns items to appropriate storage positions. Sweeps work area and carries stock in a box to replenish supply. (1-less5%)

PERFORMANCE REQUIREMENTS

6. Responsibility

Solely responsible for quality lubrication service and safe operation of customer's vehicles under little or no supervision. Must report vehicle defects and/or malfunctions to supervisor. Is responsible for the safe and skillful use as well as maintenance of all necessary tools and equipment. Is responsible for congenial customer relations.

7. Job Knowledge

Must be able to read and record information accurately. Must know how to operate various types and kinds of vehicles. Must be able to use and maintain tools and equipment needed in the job. Must have a thorough knowledge of lubrication procedures and operations.

8. Mental Application

Must take initiative to confer with supervisor about difficulties encountered. Must be able to perform repetitive operations on various types and kinds of vehicles. Must be able to work in noisy surroundings.

9. Dexterity and Accuracy

Good accuracy and the manipulative dexterity of fingers and hands is required for the use of tools and equipment. Good visual acuity is necessary.

APPENDIX C

JOB ANALYSIS SCHEDULE
CHECK-OUT CLERK, GROCERY STORE

JOB ANALYSIS SCHEDULE

1. Job title CHECK-OUT CLERK, GROCERY STORE

2. Date 8 April 1974

Number of sheets 4

3. Alternate titles

4. Dictionary title and code

5. Work Performed

Itemizes, tabulates, and bags, boxes or wraps customer purchases, operates a cash register to determine total cost of merchandise purchased, collects payment and makes change.

1. Opens up and prepares register: Receives cash-tray and register key from store manager or assistant (See comments). Walks to assigned check-out counter. Inserts key into register lock turning to unlock. Key is left in register. Presses correct button with finger to open cash drawer. Slides cash tray into register drawer. Unrolls wrapper coins by splitting roll on edge of tray. Shakes coins from wrapper into coin compartments. Removes wrappers from currency. Places currency in currency-slots. Discards currency wrappers and coin wrappers in container under counter. Pushes cash-drawer closed with hand. (2-5%)

2. Itemizes and totals customer purchases on Cash-Register: Presses clear-button with right hand to clear register for tally. Presses counter-control button with left foot to start movable counter (See comments). Picks up item from counter with left hand. Visually examines item for price. Presses correct tally button with right hand. Places item on counter. Pushes item to opposite end of counter for bagging. Presses register button with fingers of right hand. Places produce items on Scale-tray for weighing. Notes reading of indicator. Examines price sheet for produce items. Determines correct price for item from additional scales and readings on indicator. Enters correct charge into register. Totals customer order by pressing total button. (3-60%)

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3. Collects payment from customer and returns change: De-presses correct button on cash register with outside of right hand to open cash-drawer. Verbally tells customer total cost of purchases as tabulated by cash register and displayed on cash register counter readout device and as printed on itemized receipt. (3-20%)

   a. Collects payment in cash: Receives money from customer by grasping it in right hand when presented. Counts to determine amount transferred from customer in order to facilitate accurate change making. Places amount transferred on register ledge so that final examination can be made if any question arises from change making. Removes exact change in coin and currency from cash drawer with right hand and places in left, count out change from its location in left hand and presents to customer. All parties seemingly satisfied with the accuracy and exactness of the transaction, the original amount of money transferred from the customer is removed from register ledge and placed in proper receptacle in cash drawer. Pushes cash drawer closed with right hand.

   b. Collects payment in check form: Receives check from customer by grasping it in right hand when presented. Visually examines check for completeness of required information for transferability. Requests of customer proper check cashing identification, compares signatures on both documents and records on back of check any supplementary information required; returns customer identification. Places check on register ledge so that final examination can be made if any question arises from payment of total purchase price or change making when required. Notes amount of check and returns correct change to customer, if any. All parties seemingly satisfied with the accuracy and exactness of the transaction, the check is removed from the register ledge and placed under the cash tray in the cash drawer. Pushes cash drawer closed with right hand.

4. Bags and wraps customers purchase: Pulls folded bag from supply under counter. Holds top edge of bag with one hand. Inserts other hand into bag forming into open position. Places bag on counter in open position. Places heavy, solid items into bottom

of bag. Places softer, lighter items toward the top of bag. Places all items into bag. Grasps top of bag with both hands. Lifts bag from counter. Places bag into shopping cart. (1-10%)

5. Closes-down register: Pushes closing-bar across aisle. Informs manager or assistant that register is closed (see comments). Turns key to lock register. Removes key. Returns cash drawer and key to manager. (1-5%)

PERFORMANCE REQUIREMENTS

6. Responsibility

Solely responsible for the correct totaling of customers purchases. Is responsible for receiving cash or check payment from customer and returning correct change. Is responsible for congenial relations with customers.

7. Job Knowledge

Must know how to use a cash register. Must have a knowledge of simple business mathematics -- addition, subtraction, division, multiplication. Must know how to use weighing scale.

8. Mental Application

Must be able to perform repetitive operations on cash register. Must be able to work at a pace set by the number of customers. Must be able to work in noisy surroundings.

9. Dexterity and Accuracy

Extreme accuracy and the manipulative dexterity of fingers and hands is required for the operation of a cash register. Good visual acuity is necessary for reading cash register counter readout device, printed itemized receipt, and counting money.

COMMENTS

10. Equipment, Materials, and Supplies

Equipment:

Cash Register: (National Cash Register), Model #6094M(9)SI. ILC, manufactured by National Cash Register Company, Dayton, Ohio, and leased. A manually operated, electrically controlled machine used to tally and total customer's purchases. The machine consists of numbered and coded buttons for inputing prices, etc., internal workings to itemize and total the input, a counter readout device, tape printing mechanism, and a cash drawer.

Weighing Scale: (Toledo Scale), Model #1110, manufactured by Toledo Scales Company, Toledo, Ohio, and leased. A device used to determine the correct weight of an item. Item is placed on scale tray at top of scale and the indicator dial shows the correct weight of the item to the nearest tenth of a pound.

Materials:

None

Supplies:

Bags, pencils

11. Definitions of Terms

None

12. General Comments

Task 1: The store manager or assistant manager prepares every cash tray. He puts in a specific amount of money, in currency and coin, and records the amount in a ledger book. At closing time, the receipts for each cash register are totaled and this amount compared against the money in the cash drawer.

Task 2: The customer places all items on a movable counter. The checking clerk controls the movement of the counter with a control button on the floor behind the register. The counter starts and stops by pressing the button. Items move toward the checker at a constant speed.

Task 5: If additional money is needed by the check-out clerk it is obtained from the manager and credited to that particular register.

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